MANAGEMENT CONTROL IN WEAPONS SYSTEMS ACQUISITION

Joseph P. Losquadro

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

MANAGEMENT CONTROL
IN
WEAPONS SYSTEMS ACQUISITION

by

Joseph P. Losquadro

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20. (continued)

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The second half of the effort presents a proposal for a management control system for the FIREBRAND Missile acquisition project, and a model for future efforts in similar circumstances.

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Management Control in Weapons Systems Acquisition

by

Joseph P. Losquadro
Lieutenant Commander, Supply Corps, United States Navy
B.A., Colgate University, 1964

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I. INTRODUCTION

A. GENERAL

Management is a term broadly applied to many seemingly dissimilar occupations. The president of General Motors is a manager; so is the individual wearing the red hat behind the nearest McDonald's counter. While these two admittedly extreme examples conjure up many differences, one thread of commonality among managers is that they are all hired to get some kind of job done. Joseph Massie calls managers,

> ... a group of people whose job it is to direct effort toward common objectives through the activities of other people. /15:4/[1]

The definition applies equally well to the chief executive of a major corporation, the manager of a hamburger stand or a manager in the Navy.

B. BASIC THESIS

This thesis examines the management function from the perspective of a Navy Weapons Acquisition Program Manager. The basic thesis is that a key variable to success in major systems acquisition management is control. A project manager must be continually aware and in control of the status of his project. He is called upon to make significant decisions in the process of fulfilling his basic mission. To be effective, those decisions must be informed decisions.

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[1]Annotated references indicate the number of the item in the reference list and the page quoted. For example, /15:4/ stands for page 4 of Massie's work - #15 in the reference list.

C. SCOPE

Project management is a complex subject. The details of designing, developing and producing a weapons system can be very big business. Some acquisition projects are more modest yet still very complex. The FIREBRAND Anti-Ship Missile Target (ASMT) acquisition project is a relatively small project ($41.7 million in development for six prototypes), yet large enough (a six year development plan) to be described as a responsible undertaking. Though relatively small in comparison to other projects, FIREBRAND encompasses the entire range of technical and business problems associated with systems acquisition management.

This thesis explores one of those areas of concern -- that of business management -- from the perspective of establishing a formalized management control system for the project. The focus on business management is not intended to minimize the technical development aspect which must be recognized as having primary importance. A well budgeted project with tight cost controls which produces a missile that will not fly can hardly be viewed as successful.

D. OUTLINE

1. Conceptual Analysis

The first part of this thesis effort involved a study of the management process with particular emphasis on control. Chapter two makes a case for management control as a key function of managerial success. It is noted that control is effected through decisions made by the manager. The best

decisions are informed decisions. Chapter three explores the concept of management information. Most of the literature in this area is devoted to the development of large computer based management information systems (MIS). The scope of the FIREBRAND project precludes the need for a major computer based MIS. The ideas of computer MIS development are scaled down from their computer orientation to distill the elements of a good management control system. The conceptual study concludes with an analysis of two theoretical frameworks. The classical framework for planning and control systems developed by Robert Anthony [3] is described to highlight the perspective of the acquisition program manager. A framework for information systems created by G. Anthony Gorry and Michael S. Scott-Morton [13] by building on Anthony's model is examined to appreciate the emphasis on decision making in MIS development. A brief look at the Navy program manager and how he fits within these two frameworks is followed by a summary description of three control systems used in the Navy today.

2. Application

Within the concepts developed in chapters two, three and four, the second half of the thesis effort proposes a management control system for the FIREBRAND program manager. Chapter five sets the perspective with a brief sketch of the FIREBRAND project including organizational relationships, funding sources and a description of a few key reports. Chapter six reports the efforts undertaken to develop the proposed system and outlines that system. Based on the experience gained

in this thesis effort, chapter seven suggests a model procedure to follow for any future attempts at developing a management control system in similar circumstances.

II. A CASE FOR MANAGEMENT CONTROL

A. PERSPECTIVE

1. The Challenge

The challenge of the modern manager is control. The successful manager produces results. In order to merit success, particularly within the typically complex organizations of the business world or the public sector, a manager must seize control of his organization in order to carry out his responsibilities for "getting things done."

2. The Context of Control

Control must be understood within the overall context of the broad scope of the management function. As outlined by Joseph L. Massie in his excellent summary of the essential elements of management, there are seven distinct functions that describe the job of the manager [15:6-7]:

a. Decision making
b. Organizing
c. Staffing
d. Planning
e. Controlling
f. Communicating
g. Directing

The manager is seen as a coordinator, an integrator of human and material resources assembled to accomplish a specific predetermined objective or task. In this view, it is understandable that most authors see the management functions as interrelated; however, it may be argued that some are more important to the manager than others.

3. Planning and Control

Of the seven functions listed, two stand out as most critical to managerial success -- particularly in the public sector. Planning and controlling are skills that a manager must have if he is to have a productive impact on his organization. The two are so closely linked that they might even be thought of as a single function. After making the point that, "Understanding and effective use of planning skills are critical to managerial success," [5:9], Douglas C. Basil notes that,

> An integral part of the development of a plan is the design of controls to ensure that the plan is being carried out satisfactorily. Planning is but one of the skills of the manager and serves little purpose by itself ... the plan itself is ineffectual if it does not achieve the objective, and it is controls that permit the manager to know whether the plan is doing so. [5:138]

It is not enough, though, for the manager merely to establish controls. Peter Drucker makes a distinction between "controls" and "control," noting that,

> In the grammar of social institutions the word "controls" is not the plural of the word "control." Not only do more "controls" not necessarily give more "control" -- the two words in the context of social institutions have different meanings altogether. The synonyms for "controls" are measurement and information. The synonym for "control" is direction. [10:286]

However, it may be argued that a successful manager must have "controls" in order to be in "control" and able to provide direction. An important aspect of control is feedback. In order to provide proper direction, a manager must receive information on the progress of his organization toward the goals established as part of the planning process. Ross Webber lists five steps in the feedback control process [20:314]:

a. Communicating specific goals
b. Measuring actual performance
c. Reporting actual performance to appropriate people
d. Comparing actual performance with specific goals
e. Deciding to do nothing, to correct behavior, or to modify goals.

4. Example

The pre-eminence of planning and control in the hierarchy of management functions is illustrated well by the example of the typical Naval officer who is usually thrust into a management role in which such elements as organization and staffing are fairly well fixed. He must then turn to other management functions in his efforts to produce results and be successful. Unfortunately, from this author's viewpoint, most Naval officers tend to concentrate their management efforts on directing, with some attention to organization (usually re-organization), but with almost no attention to planning and therefore fruitless efforts at control. The wise manager understands and emphasizes planning and control.

B. MANAGEMENT CONTROL

1. Definition

Recognizing the link between planning and control, and the essential nature of control as "direction" that is achieved only through the selective application of controls, there is one widely accepted definition of management control that meets all of these criteria. In a frequently quoted reference, Robert Anthony associates management control with the ongoing administration of an enterprise and defines it as,

> ... the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of an organization's objectives. [3:17]

Anthony is careful to make the point that his concept combines both planning and control, but that the planning involved in the management control process is distinct from that of strategic planning which is carried out on a higher level. Anthony's perception of management control will be examined in more detail at a later point where the framework for control will be established.

2. Underlying Concepts

While not immediately obvious from the definition, there are several important concepts underlying and supporting Anthony's definition of management control. First, since the process involves managers, who are people who get things done by working with other people, there are important social elements that must be considered. The involvement of managers implies the need for judgment. Second, the term effectiveness implies getting to a specific desired end, within resource and time constraints, which further implies the need for some means of measurement to inform the manager when he has achieved that end. Third, management control involves making decisions about what to do in the future. Fourth, control is not to be misunderstood as merely blind conformance to a plan where achievement of the plan is the only concern; rather, it must take cognizance also of the assumptions around which the plan was developed and which may vary with time. And finally, Anthony maintains that a management control system must have an underlying financial structure since the dollar is the most common denominator for measurement.

3. Limited use of the systems approach

Since Anthony's definition and framework form a conceptual basis for this thesis effort, it is important to note one of the limiting aspects of that framework. Many of today's authors on the management process advocate a systems approach. Cleland and King define this approach as follows:

> The systems viewpoint is a perspective of the organization as a conglomerate of interrelated and interdependent parts ... the expression that "everything depends on everything else" is perhaps the best way of thinking about the systems viewpoint. [7:142]

When dealing with management control, there is a danger inherent in attempting to apply the systems viewpoint. Anthony makes the point in his framework that the actions and decisions associated with management control are different from other levels of the total management system. The danger of a total systems approach is that this distinction will not be considered in a systems analyst's efforts to understand the problem as a total, integrated, interdependent one. The fine point is that excessive concern for the total system may miss the point that the three activities of strategic planning, management control and operational control of Anthony's model are different and, because of that, they have different information requirements. In other words, the total systems approach may distract the management control systems planner from establishing a workable control system because of an overriding concern to integrate all sub-elements into one giant system.

.SECTION

C. DECISION ORIENTATION

1. General

Running through almost every article and book on management control is the important link between control and decision making. It is through the process of making decisions that the manager implements his plans and responds to the feedback controls that signal deviations from those plans.

2. Decision Making Process

The classical process of rational decision making involves six major steps.

.POINT BEGIN

a. Identify the problem or objective
b. Find alternative solutions or means of achieving objectives
c. Analyze and compare alternatives
d. Select the alternative to be followed
e. Implement the selected alternative
f. Evaluate the decision

Of course there are variations of these six steps, but most can be distilled down to these.

3. Types of Decisions

In establishing their own framework for management information systems, G. Anthony Gorry and Michael S. Scott-Morton draw on the work of Herbert Simon to categorize decisions into two major categories: structured and unstructured.

.SUB SECTION

a. Structured Decisions

These are the kinds of decisions that are repetetive and routine. Categorized by Simon as "programmed decisions," these are decisions made within the context of a "Definite procedure (that) has been worked out for handling them so they don't have to be treated 'de novo' each time they occur."

/13:607

b. Unstructured Decisions

These are decisions that are novel and consequential, for which "there is no cut and dried method of handling the problem because it hasn't arisen before, or because its precise nature and structure are elusive or complex ... " /13:607

4. Implications

It is clear that the two types of decisions described above will require different treatment within the management control process. In fact, within the terms defined by Anthony, most structured (or programmed) decisions belong in the sphere of operational control while unstructured decisions are characteristic of those made on the management control level. Therefore, a management control system should concentrate on supporting the manager making unstructured decisions.

5. Evaluation

An important element of management control is evaluation. Once a control system has highlighted deviations from the plan or presented other information to the manager, he must make some sort of decision directed toward getting back on course. This decision must be evaluated to assess whether it was the right decision.

D. SUMMARY

1. Planning and Control

The challenge of the modern manager is control. If planning is understood as the creation of objectives and policies, then control may be seen as a process to ensure that

those plans are carried out as intended. Control is more than merely establishing controls. The prudent manager recognizes that controls are established within certain assumptions and exercises care in assuring himself that those assumptions remain valid. Blind obedience to a plan does not ensure attainment of goals.

2. Management Control

A concept that links planning and control on the level of the ongoing administration of an enterprise is management control. This process implies a need for judgment by managers, some means of measurement to inform the manager when he has achieved his goal, and making decisions about the future. There is only limited application of a total systems approach to a management control system.

3. Decision Orientation

The whole purpose for management control information is to support decision making. Of the two major types of decisions, it is the unstructured (or nonprogrammed) decision that requires the support of the management control system. Because of the novelty associated with unstructured decisions, they must be evaluated continually.

E. CONCLUSION

The control function is the one element of management that a manager must call on first before he can be very effective. It is almost ludicrous to envision a manager making decisions or giving directions without first having sufficient control to know what is going on in his organization. The key to

effective control is information. The next chapter discusses the concept of information management and the impact it has on control.

III. THE CONCEPT OF MANAGEMENT INFORMATION SYSTEMS

A. INFORMATION AND CONTROL

One of the most important elements of management control is information. It has been observed that, "information is power." The individual who possesses the most up to date, most accurate information is likely to be the one who wields the most power. Further, having timely, accurate information is a vital key to the success of a manager, whose job is one of planning, control and direction. A manager provides direction by making decisions. In today's complex highly integrated environment those decisions can have an impact even beyond his own organization. One of the limiting factors in a manager's decision making process is the information he receives. Inaccurate information, or even accurate information received too late can lead to bad decisions.

Because information is so important to decision making which, in turn, is critical to a manager's ability to control, it must be correctly and systematically processed. This processing is usually carried on in what has become known as a Management Information System. Since control is the key management function being dealt with in this study, the term "Management Control System" will be understood to be synonomous and interchangeable with "Management Information System."

B. WHAT A MIS IS NOT

Before getting into a conceptual understanding of what a Management Information System is, it is important to clarify

what it is not. First, a management information system need not be computerized.

> Too often the term "information system" automatically brings to mind extensive computer systems, but there is nothing in the philosophy of an information system that requires computer processing. /9:20/

Second, a management information system is not the "final solution." No information system, computerized or not, will ever replace the ultimate need for human decision making. Third, a management information system is not a static thing which, once put in place, will not change for some time. Fourth, a management information system does not guarantee that proper decisions will be made -- even though the system may be a computerized program that is actually "making" repetetive decisions. And finally, a management information system is not foolproof. As with many systems, MIS requires input and review by human beings who have proven in the past to be both fallible and subject to temptations to "beat the system."

C. INFORMATION

In attempting to understand what a Management Information System is, it is important to know what "information" means. The classic distinction is made between data and information. Whereas data is any collection of raw facts, information is the result of data that has been acted upon in some way (processed) to be transformed into some more meaningful form. Information clarifies; i.e.,

> The primary function of information ... is to increase the knowledge or reduce the uncertainty of the user. /6:24/

Information has value. It has been illustrated using operations analysis techniques that the expected value of a decision process is enhanced by the addition of information; i.e., the worth of information can be quantified as the difference between the expected value of an outcome with information and the value without information.

Information is time sensitive. As information ages it's usefulness is degraded. When it gets old enough we think of it less as "information" and more as "historical data," which seems to imply a sort of regression back to the raw, less relevant state from which it came.

Information has broad impact. It can be put to many uses; for example, it may be used to:

1. Provide knowledge
2. Reduce uncertainty
3. Reduce variety
4. Aid decision making
5. Provide standards for feedback and control
6. Predict future events
7. Gain competetive advantage
8. Confuse and mislead others

Information is important. The importance of information to management cannot be underestimated. James O'Brien highlights this importance with the point that,

> Each of the management functions requires the analysis and synthesis of information before a specific decision can be made. /17:263/

To be most valuable in a business context, information must possess qualities of:

1. Reliance
2. Availability
3. Timeliness
4. Objectivity
5. Sensitivity
6. Comparability
7. Quality /16:11/

D. A DEFINITION OF MIS

There are as many definitions of Management Information Systems as there are authors writing in the field. Most make a point of noting that there is no concise way of defining a MIS; however, within the context of this study, one definition seems to capture the essence of what is required in a good Management Control System. In an article on areas to investigate for a better MIS, Robert W. Holmes uses a definition put forth by the Management Information Systems Committee of the Financial Executives' Institute, which states in part that,

> MIS is a system designed to provide selected decision oriented information needed by management to plan, control and evaluate the activities of a corporation. /14:24/

Replacing "a corporation" with "an organization" lends some more universal application to this excellent definition.

1. Decision-Orientation

The first key element in this definition is the orientation of a MIS toward decisions. Since the way that a manager effects control and direction in his organization is through decision making, information is most useful to that manager when it has a bearing on decisions he must make. In an article for a conference on the subject, Steven Alter coins the phrase "Decision Support System," calling it a "buzzword whose time has arrived," /2:39/ emphasizing the linkage between MIS and decisions.

The dedication of a MIS to support decision making is important enough to cause consideration of designing the MIS according to the nature of the decision making process it supports. Gordon B. Davis suggests that,

> The MIS should be designed to monitor programmed decisions and to identify those for which the decision rules do not seem applicable ... Nonprogrammed decisions are generally unstructured. For these, the MIS provides, where possible, a set of tools by which the decision maker can structure the decision-making process. /8:146/

2. Filtration and Condensation

A second key element in the definition offered above is that the MIS provides "selected ... information." In view of the large volume of information and the complexity of most business operations, an information system is only useful to the extent that it can condense and filter raw data and extraneous information into a distilled essence that will be relevant to the decision it seeks to support. Or, as it is put by Russell Ackoff,

> Unless the information overload to which managers are subjected is reduced, any additional information made available by a MIS cannot be expected to be used effectively. /1:B148/

However, as Alfred Rappaport points out in his counterpoint to Ackoff's article, there is an inherent danger in condensation and filtration,

> ... indiscriminate filtration and "overcondensation" can ... lead to non-salutary results. /18:B134/

The basic caution raised by Rappaport is that the filtration process must not be relegated to a low level of the organization which may lack the perspective required to make good filtration decisions. The proper measure of selectivity is very important to a good MIS since miscalculation in either direction has serious negative effects.

3. Use in Planning, Controlling and Evaluating

The final key element of the definition to be discussed here is the ultimate use of the information processed through a MIS. The information is intended for use by management in planning, controlling and evaluating the organization. It is important to realize that while these three management functions tend to merge one into the other in a sort of continuum, they are quite often performed on different levels of the organization. Since they function on different levels, they require different types of information.

E. OTHER INFLUENCES AND CONSIDERATIONS

Besides the concerns raised in an analysis of the definition, there are other elements of the business environment that impact on a MIS and which should be considered in a complete understanding of the MIS concept.

1. Style of the Manager

The personal operating style of the manager for whom the MIS is intended can be important to its design and utility. A manager who is "quantitatively oriented" may desire much more analytical information that one who is not. A manager who permits a great deal of decentralized decision making may require very little management information (or perhaps quite a lot of information if he feels a need to check on his people).

2. Nature of Data Base

The volume and complexity of the information available within the organization and the degree to which it must be processed to be useful for management decisions must be considered.

3. User Involvement

Close coordination with the ultimate user of the MIS output is critical to success of a MIS. A manager who does not understand or care about the product he gets makes a MIS nothing more than a bad reason to employ more people.

4. Existing Facilities and Flows

No management information system is a brand new creation. Usually a MIS starts out as nothing more than the formalization of already existing informal information systems. It should be recognized that not all of the informal system will (or should) be included in the formalized MIS. Cognizance must be taken of existing EDP facilities and their use employed to the maximum extent possible before embarking on potentially unnecessary investment in computer hardware and software.

5. Security

The need for security of information both within the organization and external to it must receive attention when deciding what information to include. When information is included in the formal system it tends to become more available to more people.

6. Cost

Any MIS must prove itself to be cost effective. There is no point in gathering information intended to effect savings in an organization if the cost of gathering the information exceeds the savings that can be realized. The cost/-benefit analysis, though, should take a long term view in order to be meaningful.

F. ELEMENTS OF A GOOD MIS

The measure of a good MIS is difficult to achieve on a conceptual level. What seems reasonable on paper may fail miserably in practice. Certain qualities, though, tend to be repeated throughout the literature and should at least be considered in developing or improving a MIS. These elements are:

1. Timeliness and accuracy of information
2. Decision orientation
3. Filtration and condensation to the proper degree
4. Feedback and control
5. Top management support
6. User involvement
7. Maximum use of existing facilities
8. Flexibility in design
9. Security
10. Cost effectiveness

Most of these elements have been addressed previously and are presented here by way of summary. One element not previously stressed but deserving of comment is the need for top management support of the MIS. If the boss only pays lip service to the MIS, his subordinate managers are going to have little interest in using it themselves and no concern over what it says about their own performance. If, on the other hand, subordinate evaluations are based in part on demonstrated performance through MIS indicators, then the MIS can be a powerful management control device. Another is flexibility in design. An effective MIS must be readily adaptable to accommodate change in the organization.

G. SUMMARY

"Information is power." In order for a manager to carry out his responsibilities of planning, control and direction he

must receive accurate and timely information on which to base his decisions. A management information system is developed to do this. A MIS is no panacea and by its mere existence does not guarantee that good decisions will be made; however, without an effective MIS, a manager will make good decisions largely by intuition and by accident rather than on an informed rational basis.

The primary function of information is to reduce uncertainty. Information has been shown to add value to decisions. Information is important to the process of management decision making and control. To be most valuable to management, information must be: relevant, available, timely, objective, sensitive, comparable and of high quality.

A management information system (MIS) provides selected decision-oriented information needed by management in planning and controlling an organization. As such, a MIS may be seen as synonomous with a management control system (MCS). A good MIS exists in recognition of the environment within which it operates. It must be responsive to the management that it serves as well as the user who must interface with it on a daily basis. It must be flexible. A good MIS/MCS reports exception information to management in an easy to use format. And finally, a worthwhile MIS justifies the cost of implementing and maintaining it.

IV. A FRAMEWORK FOR CONTROL IN WEAPONS ACQUISITION

A. TWO THEORETICAL FRAMEWORKS

Allusion has been made in previous chapters to a framework for control designed by Robert Anthony and a framework for management information systems developed by G. Anthony Gorry and Michael S. Scott-Morton. A more complete understanding of these frameworks is important to the design of a management control system for weapons acquisition.

1. Anthony Framework

In his seminal work, Planning and Control Systems: A Framework for Analysis, Robert N. Anthony sets forth "a framework (intended to) influence the conduct of future research in the broad topic of planning and control systems." [3:V] Anthony postulates that there are three distinct levels of planning and control efforts within organizations. They are Strategic Planning, Management Control and Operational Control.

a. Strategic Planning

The highest level of planning in the total framework, " ... strategic planning is the process of deciding on objectives of the organization, on changes in these objectives, on the resources used to attain these objectives, and on the policies that are to govern the acquisition, use and disposition of these resources." [3:16] Strategic planning connotes big plans with major consequences; the development of policies that change the character or direction of the organization. Strategic planning decisions affect the physical, financial, and

organizational framework within which the operations are carried on. The process is often complex with a broad range of social and political factors (as well as economic concerns) having a bearing. It is essentially irregular in that each problem is sufficiently different from other problems so that each must be approached differently. Strategic planning results in policies and precedents for the organization.

b. Management Control

This second level is defined by Anthony as, " ... the process by which managers assure that resources are obtained and used effectively and efficiently in the accomplishment of the organization's objectives." /3:17/[13] Management control is a process carried on within the guidelines established by strategic planning, intended to make possible the achievement of planned objectives within the guidelines. It encompasses both planning and control; although, the planning done on this level is more oriented toward current operations than strategic planning. Management control has an underlying financial structure. The end result of management control is the initiation of action within policies and precedents established in strategic planning.

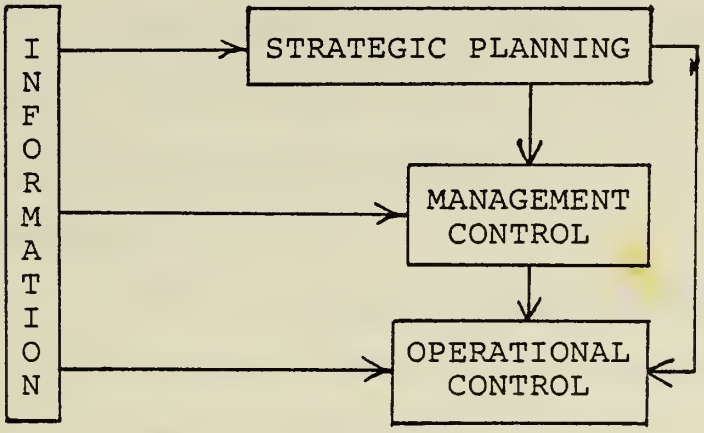
c. Operational Control

This final level, " ... is the process of assuring that specific tasks are carried out effectively and efficiently." /3:17/[14] Operational control is concerned with tasks; little or no judgment is required as to what is to be done. It focuses on execution with little planning effort. Effective operational

control results in smooth day-to-day functioning of the organization.

d. Illustration

Anthony offers a model of this process, several parts of which are reproduced as follows [3:22]:



(Figure 4-1)

The model fails to illustrate (but Anthony emphasizes in the text) the interrelationships between the various levels. Some of the Strategic Planning effort is indistinct from Management Planning which merges into Operational Control; however, the three are distinct enough to be seen as unique entities.

e. Information

A key element of the framework is Anthony's understanding of the information required on each level. Because of their different orientations, each level requires different kinds of information to support the various decisions made on each level. The unstructured, irregular nature of strategic planning dictates information that will be unique to the different problems addressed. Information will be generally

external and predictive in nature, but far less accurate than that required on the other levels. In contrast, the information required to support management control is likely to be highly integrated, more internal and historical, and more accurate than the requirements for strategic planning. In a logical progression, the information required on the operational control level is characterized as tailormade to the operation, often non-financial, precise and frequently real time.

2. Gorry -- Scott-Morton Framework

a. A Framework for MIS

In an article for Sloan Management Review [13], G. Anthony Gorry and Michael S. Scott-Morton update and refine Anthony's general framework within the context of management information systems. These authors highlight the differences in information requirements, ultimately offering the opinion that,

> ... it rarely makes sense to couple managers in the management control and strategic planning areas directly with the masses of detailed data required for operational control. [13:59]

To develop their own framework for information systems, Gorry and Scott-Morton synthesize the concepts of Herbert Simon with the framework of Anthony. Essentially, these authors take Simon's definitions of programmed and unprogrammed decisions (call them structured and unstructured to minimize the aspect of computer dependence in order to focus instead on the decision qualities) and merge them with Anthony's framework for planning and control to come up with a framework for MIS [13:62]:

	Operational Control	Management Control	Strategic Planning
Structured	Accounts Receivable	Budget Analysis	Tanker Fleet Mix
	Order Entry	Short-Term Forecasting	Warehouse and Factory Location
Semi-Structured	Production Scheduling	Variance Analysis	Mergers & Acquisitions
	Cash Management	Budget Preparation	New Product Planning
Unstructured	PERT/COST Systems	Sales and Production	R and D Planning

(Table 4-1)

b. Decision Making

Once they have coneptualized their framework, the authors go on to discuss decision making within the framework. The main points made are that:

(1) The areas of greatest concern to managers are in the lower half of the matrix where largely unstructured decisions are made.

(2) Information systems ought to be centered around the important decisions of the organization, many of which are largely unstructured which requires developing and formulating decision models.

(3) Most managers do not have great information needs; rather they have need of new methods to understand and process the information already available to them.

(4) The focus of attention should be on the critical decisions in an organization and on explicit modeling of those decisions prior to the design of information systems support.

c. Implications of the Framework

The authors summarize three implications their framework has on designing a MIS.

(1) The "totally-integrated-management-information-systems" ideas so popular in the literature are a poor design concept. It is better to consider the differences in the various areas of decision making (strategic planning, management control and operational control) and design information systems that are responsive to each area's unique information requirements.

(2) The training, background and style of decision making of managers in the three areas are often different. This means that the types of models to be used and the method of elucidating these from the managers will be different.

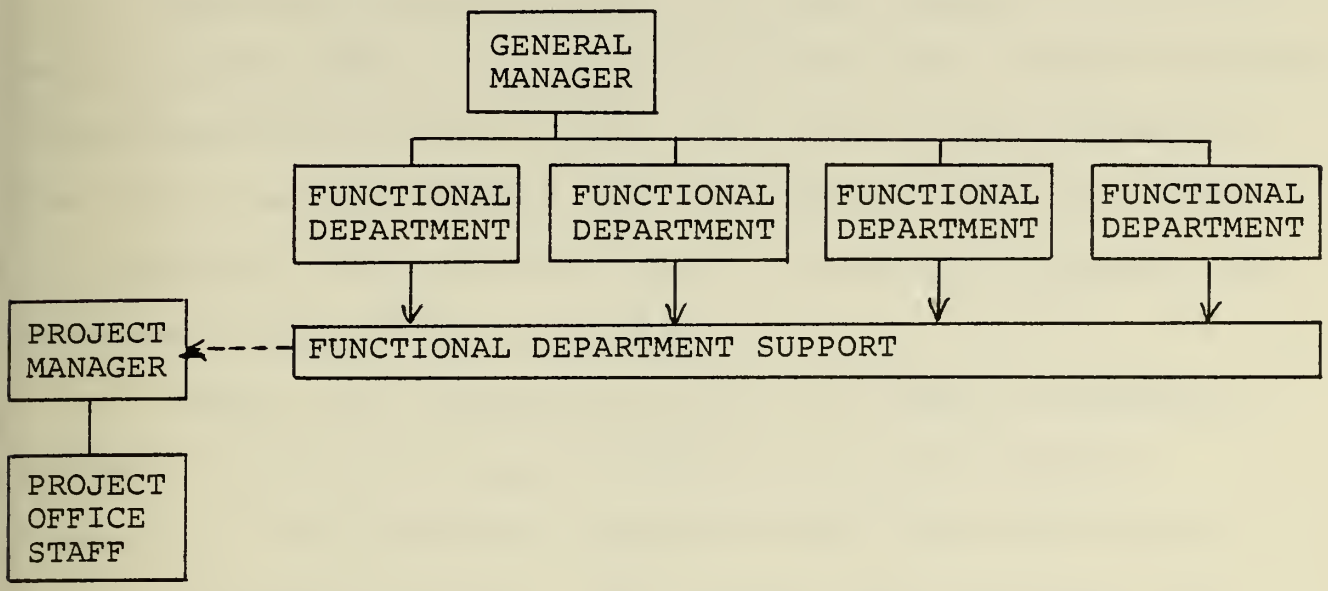
(3) The method of developing models will be different for each area because the nature of the decisions are different.

B. THE PROGRAM MANAGER AND MANAGEMENT CONTROL

1. The Matrix Organization

The Weapons Acquisition Program Manager in the Navy frequently is organized according to the principles of a matrix organization. This type of organization is characterized by a small staff assigned directly to the program manager who is charged with a specific task that is usually limited in scope

and which crosses the functional bounds of the organization. The program manager obtains support from the functional departments as required, but exercises no line authority over that support. For example:



(Figure 4-2)

This type of organization creates unique problems for the project manager. Because much of his support is not directly subordinate to him he must exercise a great degree of tact and diplomacy in obtaining resources necessary for support.

2. Management Control

It is clear from his relative position in the Navy organization that the acquisition program manager operates principally at Anthony's management control level in the framework for Planning and Control. The program manager is given a specific task, usually to develop and procure a new weapons system or develop alternative concepts. Though he is concerned with a planning horizon that extends over a period of five to

eight years (longer for larger projects), the program manager is not involved in strategic planning. The big plans with major consequences are made on much higher levels in the Navy, the Department of Defense and the Office of the President.

While the program manager does not operate on the strategic planning level, neither is he on the other extreme squarely in the operational control area. The task of the program manager is not so well defined as to preclude the need for subjective judgment. The tasks are not so routine as to require only efficient execution and no planning.

Within the understanding that the areas in Anthony's framework are not so rigidly defined as to have distinct boundaries, the acquisition program manager spans the definition of management control, with perhaps some extension into operational control depending on the status of the project. A program manager assigned to a project in its earliest phases is probably closer to the strategic planning end of management control than to operational control. As the project progresses through research and development and toward better definition and ultimately to the production phase, the program manager should mature as well toward the edge of the management control area that merges into operational control. A comparison of this parallel between the Weapons Acquisition process and Anthony's framework is illustrated in figure 4-3.

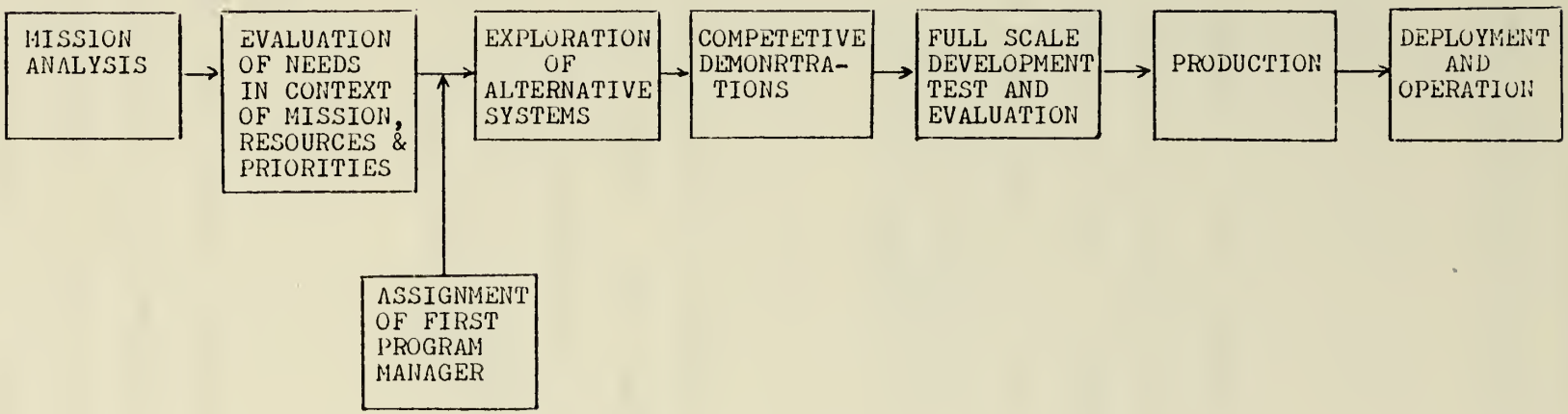
3. Decision Orientation

Recognizing that the acquisition project manager fits best into Anthony's framework within his definition of management control, it is possible to understand the general nature

WEAPONS ACQUISITION AND MANAGEMENT CONTROL

A FRAMEWORK FOR PLANNING AND CONTROL:

THE ACQUISITION PROCESS:


MISSION ANALYSIS
EVALUATION OF NEEDS IN CONTEXT OF MISSION, RESOURCES & PRIORITIES
EXPLORATION OF ALTERNATIVE SYSTEMS
COMPETETIVE DEMONRTRA-TIONS
FULL SCALE DEVELOPMENT TEST AND EVALUATION
PRODUCTION
DEPLOYMENT AND OPERATION
ASSIGNMENT OF FIRST PROGRAM MANAGER

(Figure 4-3)

of the decisions that fall to the project manager. Referring to the Gorry/Scott-Morton framework for MIS (Table 4-1), it can be seen that project manager decisions involve such things as:

a. Budget analysis
b. Short-term forecasting
c. Variance analysis
d. Budget preparation

Those decisions of greatest concern to the project manager should be expected to be of the unstructured nature where it is not possible to automate the solutions. A management information system that will be most useful in this context is one that provides information to the program manager in order that he may apply his experience and judgment in ultimately making the best decision.

4. Further Detail

The role of the program manager in weapons acquisition has been treated here only very lightly. For readers interested in a more in depth treatment of the acquisition process in general, and the program manager in particular, Arming America: How the U.S. Buys Weapons by J. Ronald Fox /11/ is highly recommended.

C. AVAILABLE CONTROL SYSTEMS

In recognition of the need for control throughout the Department of Defense, particularly in the weapons acquisition area, DOD has adopted several systems to attain this control. Three that are of particular importance to the acquisition program manager will be outlined here. They are: (1) Planning,

Programming and Budgeting System (PPBS), (2) Network techniques; e.g., Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT), and (3) Cost/Schedule Control System (C/SCS).

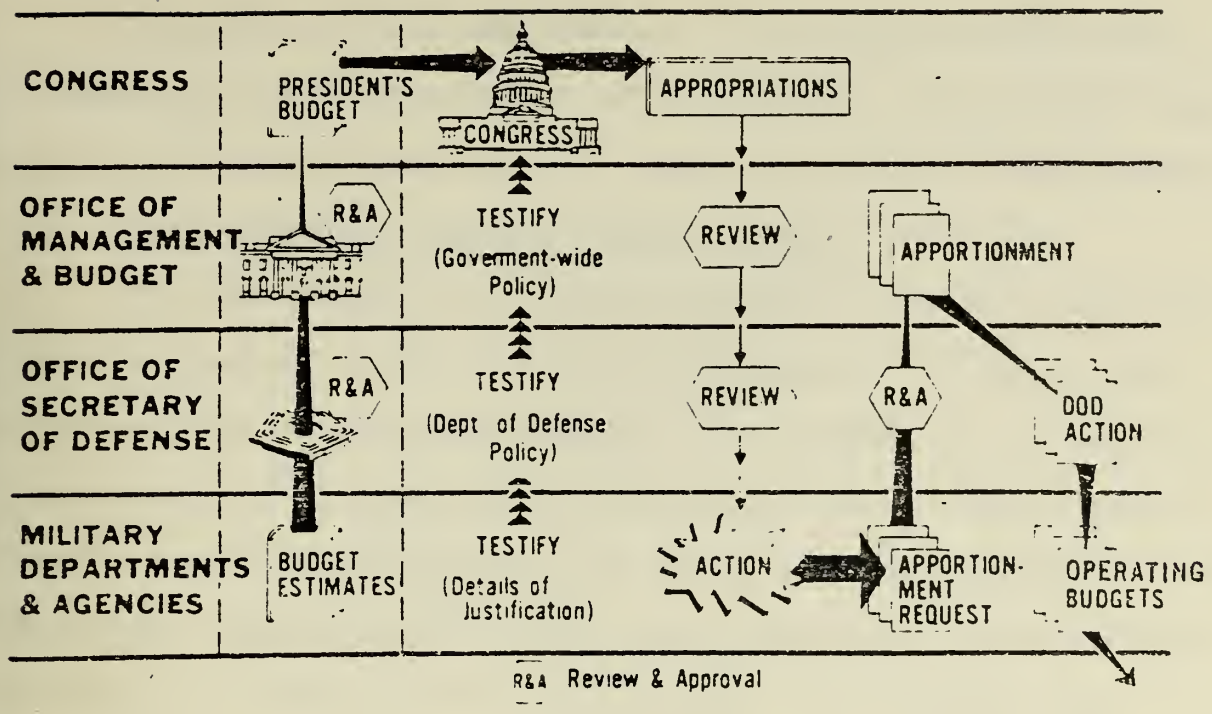
1. Planning, Programming and Budgeting (PPBS)

The DOD PPBS is a highly structured system designed to develop a budget that will be responsive to the strategic planning needs of the Department of Defense. As summarized in the General Dynamics publication Fiscal and Life Cycles of Defense Systems,

> Based on the anticipated THREAT a STRATEGY is developed. In support of that strategy, force REQUIREMENTS are developed. Based on these requirements, PROGRAMS are developed to provide, on an orderly basis, ships, aircraft, weapons systems and manpower over a period of time, with due consideration of the total cost to the nation. Lastly, funds must be BUDGETED in such a manner as to obtain the required forces and weapons systems within the resources that the nation provides. /12:12/

Most of the effort in the PPBS takes place on the higher levels of the Executive Branch and Congress. The military departments (and consequently the program managers) get actively involved in the budgeting phase of the cycle which is partially illustrated below /12:1/.

The significance to the program manager in his efforts at management control is that the PPBS is a highly structured process that requires input at very inflexible times. In order to ensure that his program is supported in the budget cycle, the program manager must be responsive to the requirements of the PPBS with strong justification for the funds required for his program. More detailed understanding of PPBS may be found in DOD Instruction 7045.7.



(Figure 4-4)

2. Networks: CPM/PERT

While not exclusively a DOD instrument of control, networks play a significant role in weapons acquisition. A network is essentially nothing more than a method of describing a series of interdependent activities, the accomplishment of which are necessary for the successful completion of a project.

Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) Networks are simply two variations on the basic network concept. CPM introduces time and cost factors which are weighed to determine that path of activities in the network which are most critical to the accomplishment of the project. PERT is essentially a variation of CPM where time factors are not known with certainty and therefore must be estimated with probabilities assigned to the various estimates.

Networks can be important to the program manager who is responsible for development of a complex weapons system that depends on several parallel and complex component developments.

3. Cost/Schedule Control System (C/SCS)

The DOD C/SCS is a system designed to measure and control cost, schedule and technical performance of contractors in the weapons acquisition process. The intent is to require all contractors to report this information in a common manner so that it can be aggregated into reports at high summary levels within DOD. There are five criteria specified in DOD Instruction 7000.2. They are (1) Organization, (2) Planning and Budgeting, (3) Accounting, (4) Analysis and (5) Revisions. Basically, the contractor is required to build a cost collection and control system around the Work Breakdown Structure (WBS) of the system under contract. When this is done in a manner consistent with the criteria in DOD Instruction 7000.2, the contractor submits reports in accordance with DOD Instruction 7000.10. These reports allow government contract administrators (and program managers) to pinpoint variances from plans to specific elements of the WBS and to assess quickly whether they have cost and/or schedule implications. Since this system is so important to management control of a weapons acquisition project, a more expanded summary of its important elements is provided in Appendix A.

D. SUMMARY

Chapters two, three and four have established the conceptual framework within which a control system for weapons

acquisition should be developed. A case has been made for planning and control as two of the most important functions of management. Robert Anthony's definition of management control has been accepted as the most precise statement of how planning and control should be understood in the acquisition context. It has been noted that the whole purpose for management control is to support decision making. An understanding of the importance of information and an appreciation for the conceptual development of a good Management Information System have been developed. As a preface to the practical evolution of a management control system, two prominent theoretical frameworks have been explored and three existing control systems have been briefly described.

The remainder of this thesis effort is aimed at applying the concepts outlined to this point to the specific case of the FIREBRAND Anti-Ship Missile acquisition project. The next chapter briefly describes the project and its organizational relationships. Following that is a description of the control system proposed for FIREBRAND. Chapter seven describes the process undertaken in this effort in terms general enough so that it may be applied to establishing a control system in some other similar management situation. The final chapter summarizes the total effort and proposes further effort on this particular project.

V. THE FIREBRAND PROJECT

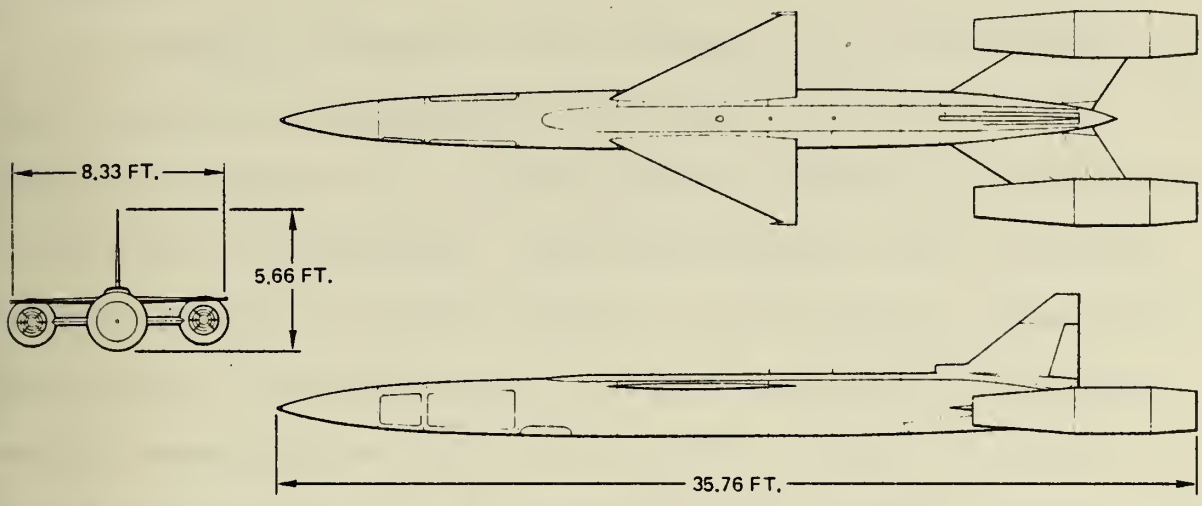
A. GENERAL BACKGROUND

Commander, Naval Air Systems Command established the mission of the FIREBRAND Anti-Ship Missile Target (ASMT) Project (APC-6) as follows:

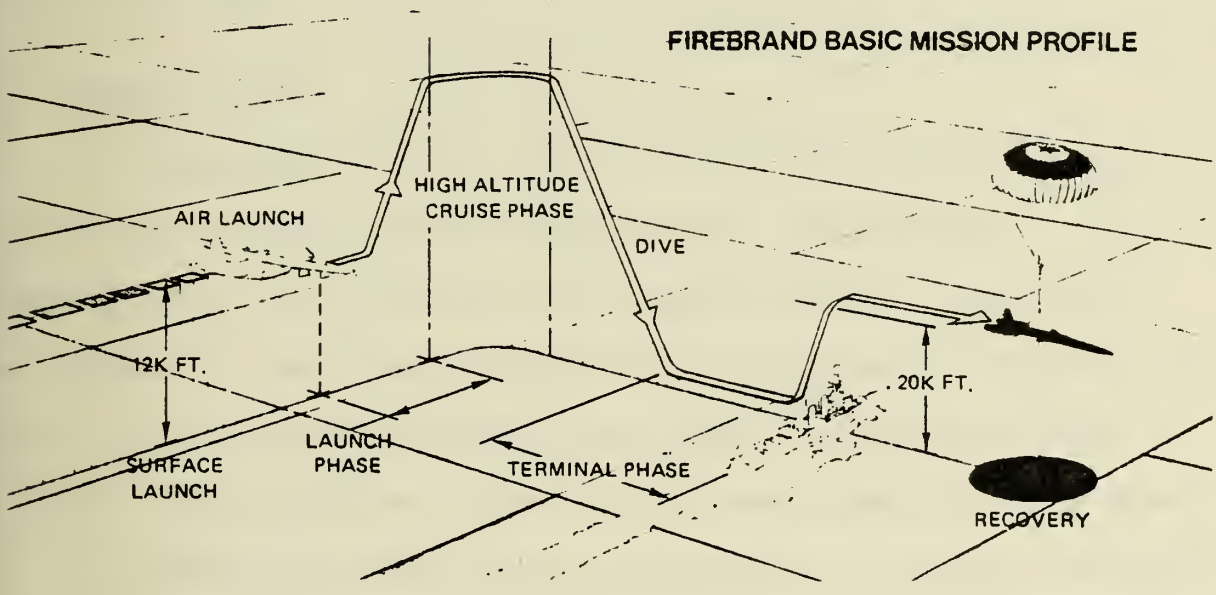
> The Project Coordinator's primary mission is to provide a fully developed, supported and reliable aerial target system which replicates the threat, at reasonable cost and on a timely basis, to commanders responsible for test and evaluation of Navy Anti-Ship Missile Defense Weapons Systems. (NAVAIRINST 5400.9D)

On May 4, 1977 a cost plus incentive fee contract was signed with Teledyne Industries, Inc. (Teledyne Ryan Aeronautical Division) calling for the design and development of the ZBQM-111A target system in accordance with government specifications provided, at a total cost of $41,713,920 which would be funded incrementally over six years.

The FIREBRAND ASMT System is intended to replicate enemy anti-ship missile threat parameters and provide a target for test and evaluation of U.S. defense systems throughout the 1980's. In order to do that, the missile system must be capable of approaching its target from a variety of dive angles to an ultimate low-level supersonic terminal dash. The target employs a simple cylindrical fuselage design with low cost, pylon mounted ram jet engines. See Figure 5-1. FIREBRAND will carry avionics to permit guidance and control including an on-board computer for anti-ship missile peculiar maneuvers and scoring and tracking systems. The missile is being



Engines	2 Marquardt Ramjets	Gross Weight	4,210 Lbs.
Booster	Thiokol Patriot (Modified)	Terminal Guidance	TACAN
Maneuverability	3 G Turns	Flight Control System	AN/AYK-14 (XN-3)
Cruise Speed	Mach 2 Plus	Remote Control System	ITCS



(Figure 5-1)

designed to be either ground launched or air launched with a modified Patriot booster rocket to carry it to initial cruise altitude.

An important concept in the design plan for FIREBRAND is the dedication to developing the system at minimum cost. To this end, maximum use is to be made of existing systems and off the shelf components. Using the booster from the Army/ Raytheon XMIM-104 Patriot surface to air missile (with minor modification), and the Navy's Control Data AN/AYK-14 flight control computer are just two examples of this principle employed on the project. To further reduce mission costs, the system is designed to be recoverable and reusable. Further specifics of the system are described in an article recently published in Aviation Week and Space Technology of 27 February 78. /19/

B. ORGANIZATION

The FIREBRAND Project Office (APC-6) is a part of the Naval Air Systems Command Headquarters organization. The small project staff works in a typical project management environment, the essence of which is depicted in Figures 5-2 and 5-3. The relationships that impact on the FIREBRAND Project Office may be grouped into three general categories:

(1) Activities external to and senior to COMNAVAIRSYSCOM
(2) Navy organizations internal to or primarily subordinate to COMNAVAIRSYSCOM, and
(3) Contractual relationships.

NAVAIR PARTIAL ORGANIZATIONAL CHART

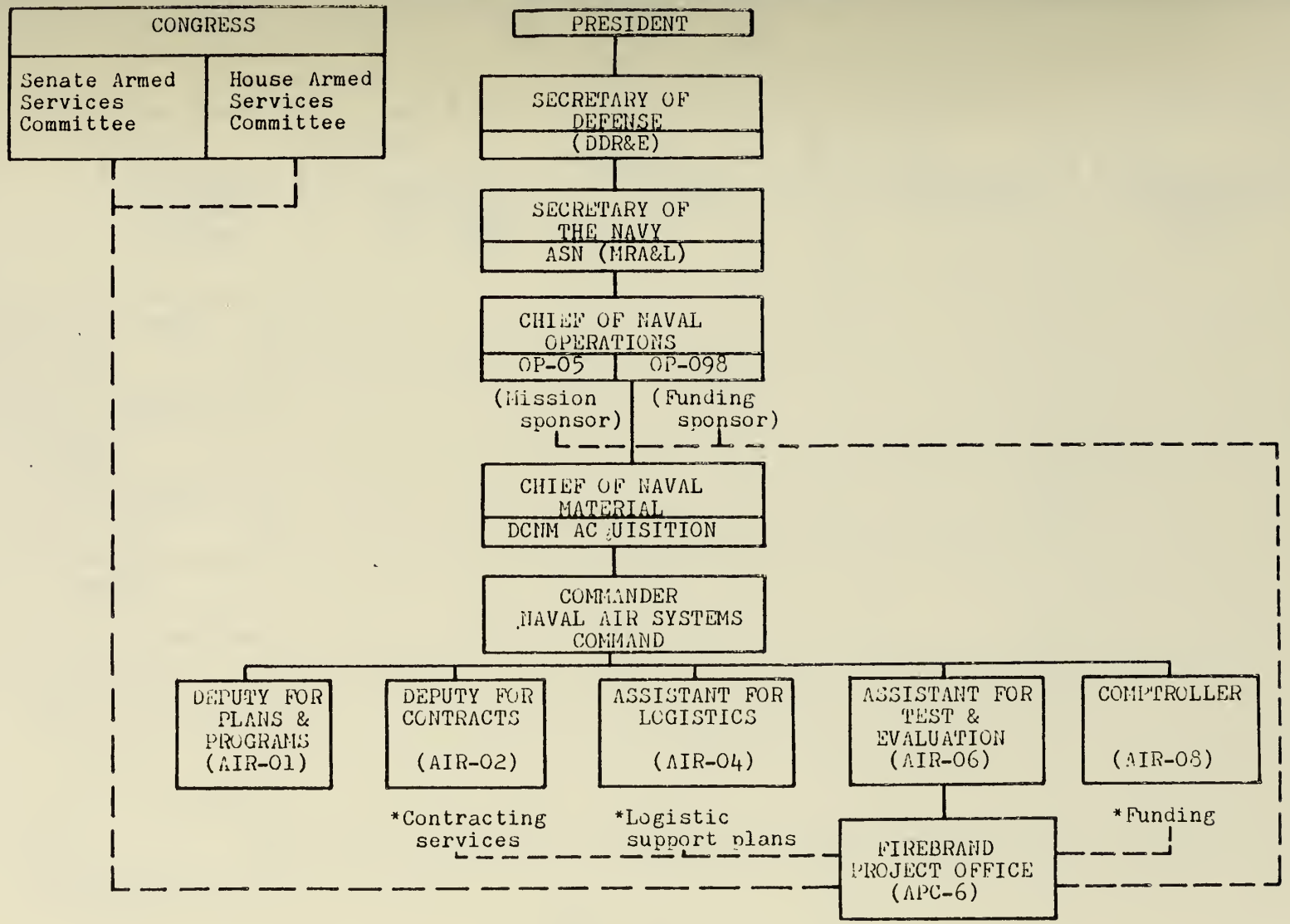


Figure 5-2

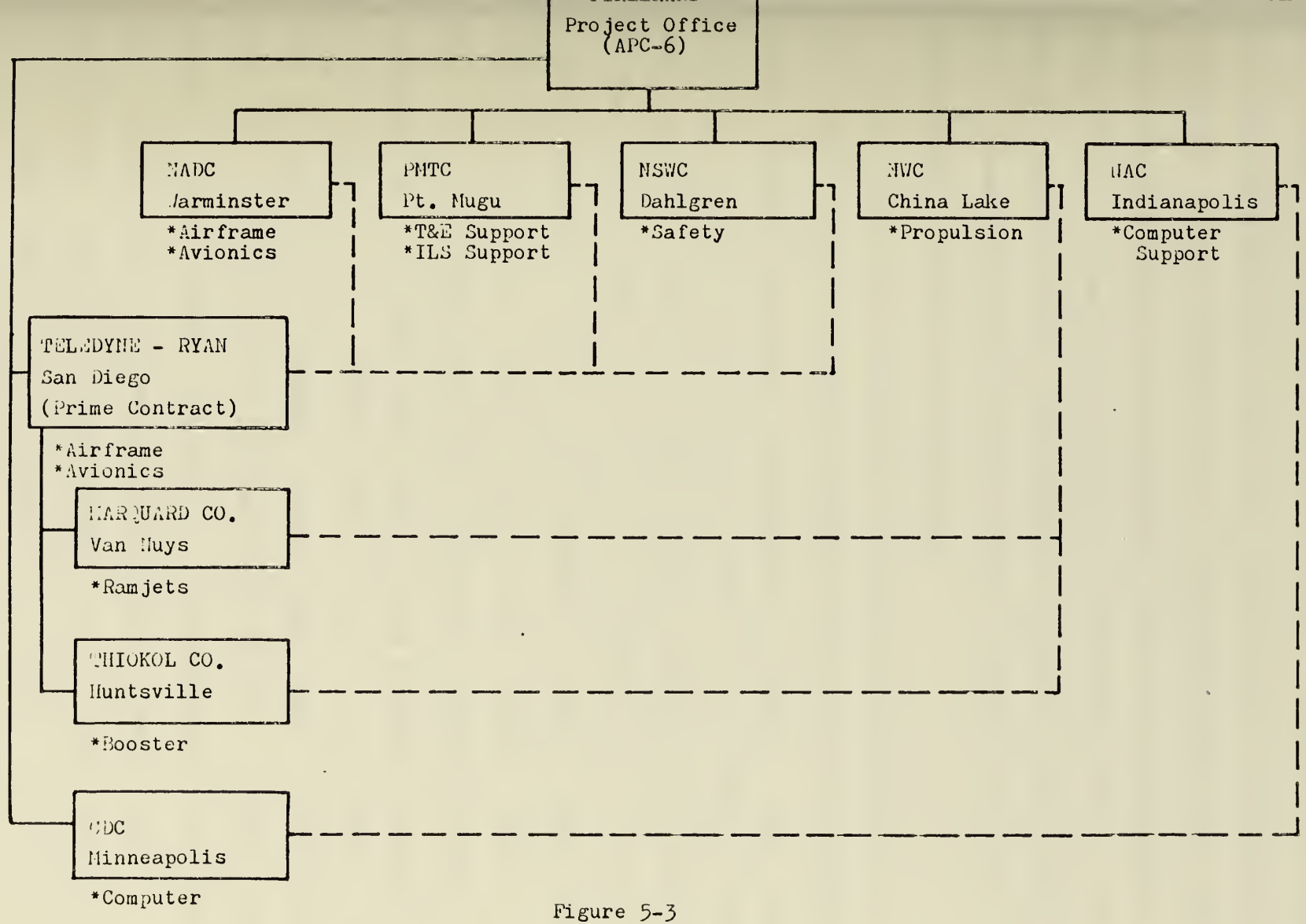

Project Office
(APC-6)
NADC
Warminster
*Airframe
*Avionics
PMTC
Pt. Mugu
*T&E Support
*ILS Support
NSWC
Dahlgren
*Safety
NWC
China Lake
*Propulsion
UAC
Indianapolis
*Computer
Support
TELEDYNE - RYAN
San Diego
(Prime Contract)
*Airframe
*Avionics
HARQUARD CO.
Van Nuys
*Ramjets
THIOKOL CO.
Huntsville
*Booster
CDC
Minneapolis
*Computer

Figure 5-3

In the first category of activities senior to COMNAVAIR, most of the relationships involve policy, funding or reports. The relationships with OPNAV are the ones most frequently encountered. It is interesting to note the closed loop that starts with Congress appropriating funds for the project. These funds ultimately get down to the Project Office, primarily through OP-098. The loop is closed by the Project Office submitting the periodic System Acquisition Report (SAR) to Congress. (Refer to Figure 5-2)

The second major category of interrelationships is the support received by the Program Manager from various elements of NAVAIR through the matrix organization concept. For example, AIR-02 provides a Contracting Officer and all normal contracting services. AIR-08 provides budget guidance and funding. In the future, AIR-04 will play an intimate role in logistical support planning. Most of the support, though, comes from external activities. Pacific Missile Test Center (PMTC), Point Mugu, is the primary test and evaluation facility which is also responsible for integrating much of the payload equipment. Naval Weapons Center (NWC), China Lake, is the technical monitor for propulsion systems, and as such, has a lot of interface with subcontractors Marquard and Thiokol. Naval Surface Weapons Center (NSWC), Dahlgren, is responsible for safety and will become more involved as the project draws closer to production. Naval Air Development Center (NADC), Warminster, is the lead laboratory responsible to oversee structural design, aerodynamics, avionics, electrical systems, etc. Naval

Avionics Center (NAC), Indianapolis, is responsible for computer support. (See Figure 5-3)

The last major category is the normal contractual relationship between the Project Office and the prime contractor. While there is no direct contractual relationship between the Project Manager and subcontractors, there is still active dialogue between Project Office personnel and subcontractor employees. As a measure of control, the Project Manager receives reports from the contractor.

C. FUNDING

1. Sources

The project office receives funds through normal channels. Funds are appropriated under project #W0611 (Anti-Ship Missile Targets) and program element #64258 (Aerial Target Systems Development). Apportionment of funds proceeds from the Congressional authorization through the office of the Secretary of Defense (Comptroller), the Navy Comptroller, Naval Material Command and ultimately to Naval Air Systems Command Comptroller (AIR-08) from whom the project office receives authorization to obligate. Perhaps more important than this formal funding structure is the informal liaison between the project office and its OPNAV sponsors. In parallel with the formalized budget submission process is an informal dialogue that exists between the project office and OPNAV (OP-05 and OP-098). As tradeoffs are being made at the CNO/DOD level, these mission and funding sponsors require support from the project office. It is necessary for the program manager to

be able to respond quickly (often within only a matter of hours) as to the impact on his project of changes in funding levels or time constraints.

2. Authorizations

The program manager obtains assistance from NAVAIR subordinates and field activities by tasking them with an AIRTASK and funding them through use of a work request. It is important to the program manager to ensure that funds authorized through this process are utilized for their intended purpose and are obligated at a rate consistent with full obligation by the end of the fiscal year.

D. REPORTS

The project office receives reports from subordinate activities and is required, in turn, to report periodically to higher authority. Some of the more significant reports are discussed here.

1. Examples of Incoming Reports

Most of the incoming reports are received from the contractor as dictated by the Contract Data Requirements List of the basic contract. Some of the reports important to management control are described briefly here.

a. Hot Line Report

This is a formalized requirement for the contractor to report by telephone as required to the program manager, any significant problems with the contract.

b. Letter Progress Report

This is a monthly report of the progress made during the previous month. It is a narrative of what has been

done by the contractor (or other submitter) during the report period, highlighting problems encountered and plans for the immediate future.

c. Progress/Status Meeting Report

This report is a summary of the results of each formal program review conducted by the project office.

d. Cost Performance Report

This is a monthly report of cost and schedule data submitted in accordance with the DOD Cost/Schedule System discussed in Appendix A.

2. Outgoing Reports

In order to keep more senior levels of management apprised of the progress of the development, periodic reports are required.

a. NAVAIR Management Information Center Report

Periodically (usually semi-annually) the program manager presents a report of the overall progress of the project to COMNAVAIRSYSCOM and directors of the divisions within NAVAIR headquarters. This report encompasses technical development progress, funding profile, an overall assessment of the program and areas of future risk.

b. NAVMAT Quarterly Project Status Report

This report details the status of the project from the standpoint of schedule, technical, financial and resources over the current fiscal year and projected forward for three fiscal years. The program manager must make a judgment as to whether each of these categories is to be rated as satisfactory (green), marginal (yellow) or unsatisfactory (red) and be

prepared to defend that judgment with facts.

c. NAVAIR Obligation/Expenditure Report

This report is made quarterly to the NAVAIR Comptroller (AIR-08) and reports obligations and expenditures to date for the project.

Of course these are not the only reports received by or required of the program manager, but are described here to provide some insight into a few typical report requirements placed on the project office.

E. SUMMARY

The FIREBRAND Project Manager is tasked with developing and producing an anti-ship missile target intended for testing U.S. defenses against enemy anti-ship cruise missiles. The project presently is well into the developmental stage of the weapons acquisition process. The project office operates within a matrix organization. Though funding patterns are not unique, the informal dialogue appears more important to success than the formal budget structure. To maintain control of the project, the program manager receives regular reports from contractors and field activities. In turn, he must report periodically to higher management. In order to maintain management control and make required reports, the program manager must be aware of what is happening on his project. A formalized management control system can help organize the large volume of data into a more meaningful format to provide responsive support to this need. The next chapter proposes one possible system.

VI. A MANAGEMENT CONTROL SYSTEM FOR FIREBRAND

A. SCOPE

The FIREBRAND Project Manager needs a formalized system to keep himself informed as to the progress of his program toward fulfilling the mission requirement, to, "provide a fully developed, supported and reliable aerial target, at reasonable cost and on a timely basis ..." (NAVAIRINST 5400.9D of 15 June 77). From this brief statement, it is clear that the manager must be concerned with performance (reliability), cost and schedule during development and production of the weapons system. In order to ensure that required levels of performance are achieved within a scheduled time frame and at or below a previously budgeted cost, the program manager must plan his project, develop a schedule and then control the progress to see that desired goals are met. At the time of this effort, a FIREBRAND program master plan had been established, a detailed development schedule existed and informal controls were present. This chapter reports the efforts undertaken to develop a system of formal tools designed to enhance the control effort.

B. OVERVIEW

The total management control system should be designed to provide rapid adequate communication of information to the program manager, usable for taking action in making decisions necessary to guide the project to successful completion. In preparing this proposal, the first step was to identify and

classify the decisions required to be made. Next, it was necessary to determine what information was required and then whether that information was available. Finally, the information to be reported was arranged in a format most efficient for the decision maker.

C. DECISION ANALYSIS

1. General Nature of Decisions

Having recognized that the FIREBRAND project is well into the development stage of the weapons acquisition cycle and therefore squarely in the Management Control area of Robert Anthony's framework (see figure 4-3), it may be concluded that the nature of the decisions to be made by the FIREBRAND program manager are largely unstructured. This quality implies a large degree of unpredictability in terms of the exact type and timing of many of these decisions. The most important decisions are likely to be problem derived; i.e., required only because some problem (whether anticipated or not) has arisen. This whole orientation toward problems that are generally not predicted makes it mandatory that the information being provided to the manager present as many alternatives and as much flexibility as is practical to obtain. For example, in order to be responsive to the informal budget process described in chapter five, the program manager must know precisely where his project stands (both in terms of cost and schedule) so that he can report the impact of changes conjectured by OPNAV sponsors in their efforts to make tradeoffs.

2. Basic Structure

The decisions required of the FIREBRAND program manager were identified as falling within two major categories.

a. Technical Decisions

The development of a major weapons system requires a considerable number of complex technical decisions. These decisions include such engineering concerns as, for example, the aerodynamic qualities of the design, the choice of propulsion systems, control of the weight of the missile to remain within fuel capabilities while still performing the required mission,etc. While some initial effort was undertaken in this area, time limitations and the lack of sufficient engineering expertise on the part of the author limited any substantial results.

b. Business Decisions

In close parallel with the technical development of the weapons system, there are significant business oriented decisions which must be made in order to fulfill the mission. These business concerns include such elements as budgeting, contracting and financial control. It was within this area that the efforts of this project were concentrated.

3. Master Plan

The basic building block of the management control system is a master plan that includes: (1) a Master Engineering Development Plan, (2) a Master Budget Plan and (3) a Master Contracting Plan. The master plan is intended to be reviewed at least monthly by the project manager based on information

provided by project office staff members, subordinate field activities and the contractor. The format must consider the progress of each major element against past performance and projecting to the future. The monthly letter progress report, the cost performance report and information from the DOD PPBS system are major sources of information for updating the master plan.

a. Master Engineering Development Plan

This plan is a summary of the progress of the technical development of the weapons system. The plan is aligned to the Work Breakdown Structure. A dependency network outlining the major program development milestones (e.g., Preliminary Design Review, Critical Design Review, Preflight Program Review, etc.) and the major intermediate steps on which these critical milestones depend is the base upon which the plan is built. Such a network identifying the planned start and completion dates and the activity responsible for each intermediate task has been developed for FIREBRAND by Systems Consultants Inc. To be useful as a management control device, this network must be expanded with greater detail of steps which must be accomplished (and decisions which must be made) in the completion of the task; then, on a periodic basis (monthly) the project manager must be informed as to whether the steps are on schedule. When schedule slippage is observed, the effect on other tasks must be clear. Alternatives should be presented which consider cost impact, in order for the project manager to render a decision.

It is anticipated that significant problems will arise that must be communicated to the project manager for a decision outside the normal course of the regular monthly review of the Master Engineering Plan. These problems may arise out of program reviews, informal information from the contractor (hot line reports), failure reports, test and evaluation reports, or engineering change proposals. While this input must be used to update the Master Engineering Plan on a routine basis, it must also be transmitted to the project manager for any action/decision that may be required.

b. Master Budget Plan

The Budget Plan has been developed according to the demands of the DOD Planning Programming and Budgeting System (PPBS) which establishes specific and inflexible requirements for input by DOD components and the informal requirements of OPNAV sponsors. The budget plan includes a budget formulation element and a budget execution element. Budget formulation encompasses the effort involved in preparing, presenting and defending the project's portion of the federal budget. The process is highly structured and must be responsive to external forces; e.g., OSD, NAVMAT, NAVAIR which are described in DODINST 7045.7. The primary question to be addressed in budget formulation is whether sufficient funds are requested to meet the required schedule and reliability goals. The funding requirement must be supported by hard requirements that must be able to withstand critical analysis at all levels up through OSD review; therefore, the justification for requested funding levels must be solid.

Budget execution includes procedures employed subsequent to budget submission and approval. In order to maintain budget formulation credibility it is imperative that funds authorized be obligated at a rate consistent with full obligation by the end of the fiscal year and in accordance with the intent for which funds were authorized. The budget execution plan is developed for each fiscal year as funds are authorized. A separate plan is established for each activity receiving funding through the project office. Monthly reports of obligations are received and reviewed.

c. Master Contracting Plan

A Contract Management Plan is that portion of the master plan that concentrates on preparation and administration of contracts or other instruments of agreement (in the case of subordinate NAVAIR activities). In the case of new contracts/ agreements in the negotiation process, the project manager must be kept informed of the progress of any negotiations until the ultimate agreement and signing of the contract. The plan is also concerned with Contract Administration which involves the complex area of ensuring that the contractor meets the terms of the contract. The program manager requires reports on the major areas of financial and cost control, performance standards and schedule. A particularly important element of contract administration is the maintenance of close control over engineering changes. A number of minor concerns must also receive attention; including, government equipment, safety, subcontract administration, etc.

4. Business Decision Elements

Within the Master Budget Plan and the Master Contracting Plan which are the two elements of the Master Plan that fall under the general category of business decisions, there are several important sub-elements under which specific decision questions may be enumerated. These elements are: (1) Budget Formualtion, (2) Budget Execution, (3) Procurement and Contract Administration, (4) Financial Control and a general category of (5) Project Administration. Each of these sub-elements and examples of the decisions required is discussed in the following subparagraphs.

a. Budget Formulation

This element involves the very structured process of developing, submitting and defending budget estimates within the DOD Planning, Programming and Budgeting System (PPBS). The timing of PPBS budget submissions is usually determined by external forces; e.g., OSD, NAVMAT, NAVAIR. The process of developing budget estimates must recognize these submission time frames and be scheduled accordingly. DOD Instruction 7045.7 prescribes actions required during the calendar year with respect to the PPBS system. Decisions which are required of the program manager with regard to formulating a budget within the guidelines of this system are:

(1) Do the policies expressed in Presidential, OSD and Navy guidance documents have any direct effect on this project? What accommodations are required?

(2) Are the resources proposed sufficient to accomplish the goals of the project?

(3) Is the justification of the budget submission substantial enough to ensure that required funds will be authorized?

(4) What position/input is required for testimony to Congress?

(5) Are there budget related decisions being made on other programs which may impact on this project; e.g., cancellations or accelerations of other programs that could affect funds available within RD&E accounts?

(6) What is the impact on the project in terms of quantities/schedule of either a reduction or an increase in amounts budgeted?

b. Budget Execution

This element includes procedures employed subsequent to budget submission and approval. The focus is on current year funds and their use once they have been authorized by Congress and apportioned through the Executive Branch. Decisions on cost implications are discussed in sub-paragraph 4d. Once obligational authority has been received by the project office, it must be further apportioned to contractors and subordinate supporting commands. Some of the decisions required within the budget execution element are:

(1) Are current year funds sufficient?

(2) Are the requirements of contractors and subordinate activities valid and well justified?

(3) Are current year funds being obligated at a rate consistent with full obligation of all annual appropriations by the end of the fiscal year?

(4) Are funds being spent as intended? Are incentives working?

(5) What flexibility is available to shift funds?

c. Contracting

Included in this element are the decisions that must be made in contracting with the defense industry and establishing commitments with subordinate commands. The present status of this project, well into the development phase, requires the focus of attention in the contracting element beyond the early decisions of source selection, type of contract, etc. Decisions on procurement include:

(1) Are the various contracts appropriate in type and terms?

(2) Are government contract changes valid? Are they properly authorized? Are they necessary?

(3) Are contractor change proposals necessary? Are they being processed in a timely manner so as to avoid delays?

(4) Are incentives in contracts eliciting the performance desired?

d. Financial Control

The key element of financial control can affect the decisions of the program manager in all areas. The scarcity of funds and intense outside interest focused on DOD funding dictate that the program manager pay careful attention to control of the funds at his disposal.

(1) Is progress being achieved at a cost higher, or lower, than budgeted? Is work performed, controlled in sufficient detail so as to preclude overrun?

(2) What are the cost impacts of program slippage? What alternatives exist?

(3) Are the costs of contract modifications within funding authority?

(4) Are contract costs reported by the contractor valid? Are they reasonable? Do they reflect effort that can be related to the project?

(5) Are overhead rates valid? Is the business base changing? What impact?

e. Project Administration

This final element includes decisions not otherwise categorized, such as travel, major meetings/reviews, reports, etc. Decisions in this area involve such questions as:

(1) What major milestones are required? (DSARC, etc.)

(2) Is proposed travel necessary? Are the right people planned for the trip.

(3) Is the program review scheduled at an appropriate time?

(4) Are incoming reports routed to the appropriate responsible individual? Is the information useful and used?

(5) Are outgoing reports in fact required? Is the data being provided accurate and complete? Will it accomplish the purpose intended by the report without detriment to the project?

(6) Are personnel resources adequate to get the job done?

D. INFORMATION ANALYSIS

Within the context of the business decision elements established above, there exist needs for information to support those decisions. This section discusses the nature of information required and suggests potential sources for that information.

1. Budget Formulation

In working to formulate his portion of the NAVAIR section of the DOD Budget, the FIREBRAND Project Manager needs to know such things as the schedule of input required, the format for submission and the detail of information required. Most of this information comes from OPNAV through NAVAIR-08 in the form of budget calls, etc. as described in the PPBS instructions. Actually, the information is obtainable on a more informal basis from the program's funding sponsor in OPNAV (OP-098) as illustrated in figure 5-2. Once the reporting schedule is known, the actual data must be collected from field activities and contractors for support of future fiscal year budgets.

Within the structure of the budget process, an activity usually receives an indication of the funding that may be made available for future years. The program manager needs to know what these figures are for his project and whether those projections are sufficient to meet his needs.

2. Budget Execution

In this very important element of overall management control, the program manager must decide how much money to authorize to field activities and contractors. One important factor in making this decision is input from field activities and contractors as to their needs for the fiscal year (or quarter) under consideration. Once the funds have been authorized, it is critical to the success of the project to ensure that those funds are obligated according to plan. In the context of single year appropriations, funds which are not used in the year for which they are appropriated may not be carried over to succeeding years. The program manager must know how much has been obligated within each activity that holds funds and a projection of the future. Flexibility in shifting funds is particularly important in this area, so the program manager must know where he can get funds to cover legitimate shortages.

3. Contracting

In this element, the program manager needs to be kept informed as to the status of any ongoing contract negotiations. Especially important in contract administration is the process of changes. The program manager needs to know what changes have been proposed, by whom, how much they will cost and what impact they will have on the rest of the project. This information comes through formal change proposals by contractors and suggestions made by government personnel.

4. Financial and Cost Control

To keep track of this critical element, the program manager needs to know how much money has been authorized in

total, where it has been allocated and whether it is being spent for intended purposes consistent with complete obligation. He must know whether money is being spent consistent with a contractor's plan or if costs vary significantly from what was anticipated.

5. Project Administration

To make effective decisions in this area, the project manager must know what travel is required and which skills must be present. He must be aware of when reports are due at the project office and what the schedule for outgoing reports is.

E. A CONTROL SYSTEM PROPOSAL

1. General

The analysis of decisions and information highlights a need for information that provides the program manager a significant degree of flexibility required to respond to changing demands in the evolution of the development of the missile. The system envisioned to provide that information must be responsive to two different kinds of demands. There are those demands that are fairly well predictable. For example, in the process of developing the airframe, wind tunnel tests were conducted. It was obvious that if the tests failed, some contingency configuration plan needed to be ready. This kind of decision can be anticipated in time to gather information from various sources, and have alternatives available in advance. The information system supporting this type of decision might be called a Dynamic Management Information System. On the other hand, the program manager must make many decisions in

response to problems that emerge without a great degree of anticipation. A good example of this kind of decision is the short fuzed response to OPNAV during the budget process. The type of system required to support this kind of decision might be called a Static Management Information System, where the objective is not so much to have alternatives available, but rather to have sources for the information ready to respond. This system may be seen conceptually in a form similar to figure 6-1.

2. Inputs

As in any information/control system, the basic effort involved in the processing and conversion of existing information inputs into a more useful format intended to support the decision maker. Some of the inputs being converted by the FIREBRAND MCS are discussed here.

a. Budget Guidance

Information received from the NAVAIR Comptroller (08) and others regarding the schedule, format, target dollar levels, etc. of the various budget submissions are received and channelled, for example, into the Management Notebook.

b. Letter Progress Reports

Monthly narrative reports of progress from contractors and others are converted into information to update the planning calendar, budget control reports, contract status reports, etc. For example, the letter progress report from TRA may contain information that results in a decision to delay on-site review which requires revising the planning calendar.

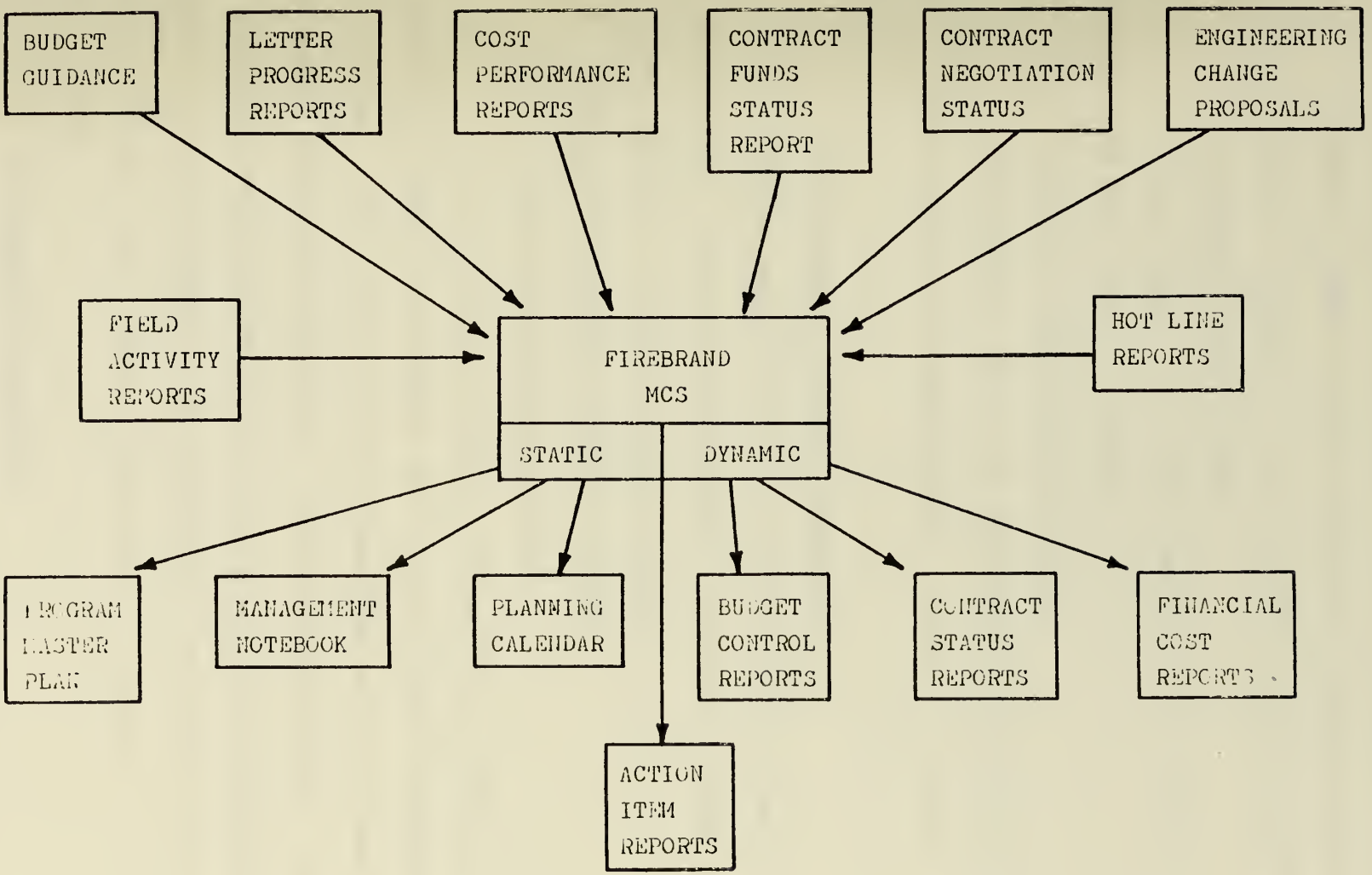

BUDGET GUIDANCE
LETTER PROGRESS REPORTS
COST PERFORMANCE REPORTS
CONTRACT FUNDS STATUS REPORT
CONTRACT NEGOTIATION STATUS
ENGINEERING CHANGE PROPOSALS
FIELD ACTIVITY REPORTS
FIREBRAND MCS
HOT LINE REPORTS
STATIC
DYNAMIC
PROGRAM MASTER PLAN
MANAGEMENT NOTEBOOK
PLANNING CALENDAR
BUDGET CONTROL REPORTS
CONTRACT STATUS REPORTS
FINANCIAL COST REPORTS
ACTION ITEM REPORTS

Figure 6-1

c. Cost Performance Reports

This major input from the Cost/Schedule Control System is used to update budget control, contract status and financial control elements of the dynamic control system.

d. Contract Funds Status

This report is a major source for updating the financial and cost control report.

e. Contract Negotiation Status

Information from the Procuring Contracting Officer (PCO) on the status of negotiations, feeds the contract status report.

f. Engineering Change Proposals

These modifications to previously agreed terms of the development contract will affect contract status and financial cost control elements, among others.

3. Static Management Control System

a. Program Master Plan (PMP)

As alluded to earlier, this plan already exists. It should be made an integral part of the total management control system. The PMP should be consulted and reviewed with each major decision during the life of the project. The goals and schedule established by this plan must be considered as budgets are formulated or as contracts are established or modified. The PMP will have an important influence on the planning calendar.

b. Management Notebook

This element of the control system is intended to provide the source of information for those short fuzed

decisions required of the program manager. The management notebook should contain the highlights from elements of the dynamic control system. Broken down into three major sections of budget control, financial and cost control and contract status, this notebook should have the important, "big picture" information needed to make initial judgments on problems. For example, the budget control section must include the total budget picture for the life of the contract broken down by fiscal years and showing amounts of funds required, current budget estimates and shortfalls.

In recognition of the nature of the problems to be supported by information in the management notebook, it should include within each section the potential sources for information that is not readily available within the program office. The recent (July 1978) issue of the FIREBRAND Telephone Directory is an excellent base for this kind of information. It already contains names, addresses and telephone numbers of key personnel in the following government and contractor organizations:

(1) FIREBRAND Project Office (APC-6)
(2) Armament Development & Test Center (Elgin AFB)
(3) Chief of Naval Operations (CNO)
(4) Defense Contract Administration Services (DCAS) Office
(5) DCAS Planning Office Teledyne Ryan Aeronautical
(6) Naval Air Development Center (NADC) Warminster
(7) Naval Air Systems Command (NAVAIR)
(8) NAVAIR, Point Mugu (AIR-630)
(9) Naval Avionics Center (NAC)
(10) Naval Intelligence Support Center (NISC)
(11) Naval Material Command (NAVMAT)
(12) Naval Sea Systems Command (NAVSEA)
(13) Naval Surface Weapons Center (NSWC) Dahlgren
(14) Naval Weapons Center (NWC) China Lake
(15) Office of the Secretary of Defense (OSD)
(16) Office of the Assistant Secretary of the Navy
(17) Operational Test and Evaluation Force (OPTEVFOR)

(18) Pacific Missile Test Center (PMTC) Point Mugu
(19) U.S. Army Missile Material Readiness Command (MIRCOM)
(20) White Sands Missile Range, New Mexico
(21) Bird Engineering Research Associates
(22) Control Data Corporation (CDC)
(23) Mantech of New Jersey
(24) Marquardt Company, Van Nuys
(25) Systems Consultants Inc. (SCI)
(26) Teledyne Ryan Aeronautical (TRA) San Diego
(27) Thiokol Corporation, Huntsville
(28) Universal Systems Inc.

This existing information could be expanded to include other agencies which have the potential to provide information or assistance on emerging problems. A partial list of activities not presently listed in the FIREBRAND telephone book but which may be included in the management notebook are:

(1) Office of Management and Budget
(2) Congressional Staff Officers
(3) Office of Legislative Affairs
(4) NAVSUP functional codes
(5) NAVCOMPT functional codes
(6) Office of Federal Procurement Policy
(7) General Accounting Office
(8) Naval Postgraduate School
(9) Other Program Managers
(10) Naval Audit Service (consulting Services)

Some effort should be made to summarize the expertise available from all of these activities, the procedures for obtaining services and key personnel to be contacted. A cross reference of these sources according to their areas of expertise would also be useful.

What has been described here are only a few examples of things that should be included in the management notebook. Any significant source document or secondary source of information should be considered for inclusion.

c. Planning Calendar

The planning calendar really belongs in both the static and dynamic systems. It is envisioned as a tool that will focus the program manager's attention on significant events both in the long range and in the near term. It is not intended to take the place of the complex technical development schedule which should be an integral part of the master engineering plan. The planning calendar is the source for recording major milestones to facilitate the administrative support for them.

Three specific formats are suggested. Format One is a one page look at the entire life of the project with major events annotated as they are planned to occur. This format should be updated as the program master plan changes. The intent is to focus on major events and their perspective within the overall project.

Format Two should be a three month forecast illustrating the current and following two months. This display should record more detailed events that tend to support the major milestones on Format One.

Format Three should reflect the program manager's schedule for the current week and one or two succeeding weeks.

4. Dynamic Management Control System

a. Budget Control Reports

This section of the management control system should contain all information necessary to prepare and submit budget requests and to control budget execution. As a matter

of historical record, the submission guidelines provided by higher authority along with a copy of DOD Instruction 7045.7 and subordinate implementing instructions should be included as part of this section. Also, a chronological history of all previous formal budget submittals and responses to informal requests from OPNAV sponsors should be filled in this section as well. Previous back-up data provided by contractors and NAVAIR field activities is also appropriate for inclusion. Even though it may be more appropriate to include in the management notebook of the static system, information on budget flexibility may also be appropriately included here. Information that will enable the program manager to respond to "what if" type questions from OPNAV, Congress or others must be readily available. For example, the program manager must be able to respond to a conjecture that asks, "What if we cut your budget $2,000,000 in FY80?" or "How much can we save by stretching the project out six months?"

The kind of information necessary for control of budget execution is that which will provide the most flexibility to the program manager. At the front, there should be a record of funds authorized, how they have been apportioned for the current fiscal year and planned for the next two fiscal years. Figure 6-2 is a suggested format that will accommodate these needs. As changes are made to a given fiscal year, the appropriate page must be updated and replaced. Within the budget execution element, the program manager needs to know how each activity is performing in obligating funds for the current

FIREBRAND
SUMMARY OF
BUDGET EXECUTION
FY____

ACTIVITY	TASK DESCRIPTION	FUNDS REQUESTED	FUNDS AUTHORIZED

Prepared By: _____

Date: _____

Figure 6-2

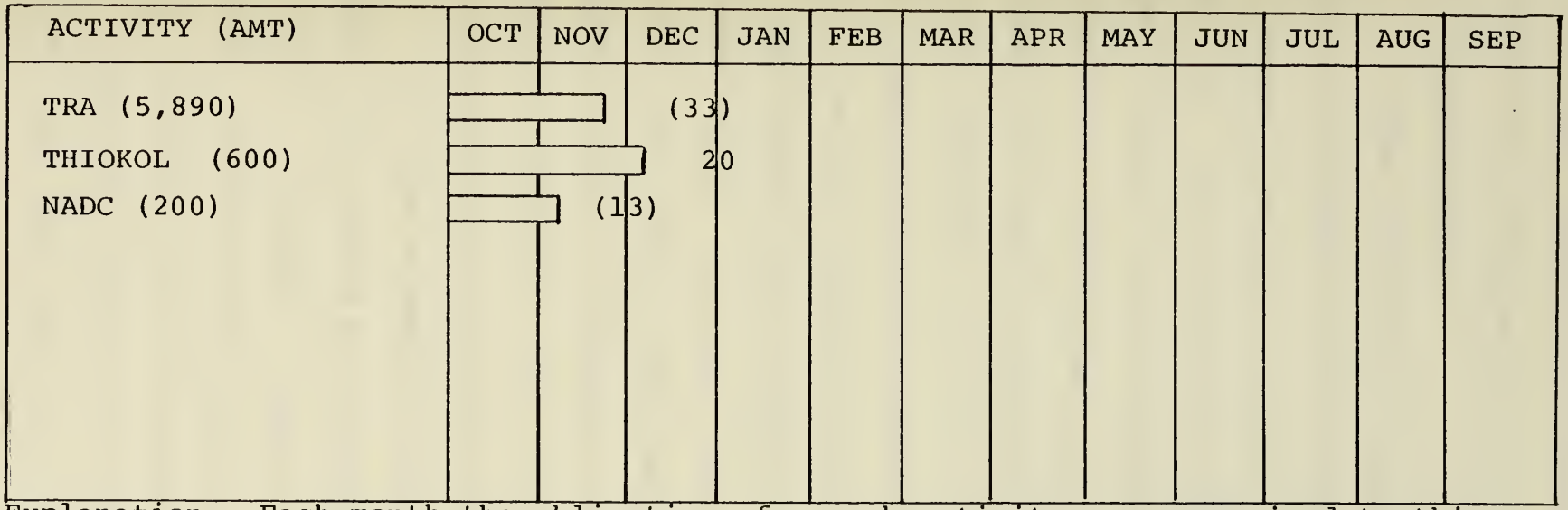
fiscal year. This data must be displayed on a single page to facilitate making adjustments as required. Figure 6-3 suggests a summary obligation status report that highlights obligations against plan. Finally, the detailed progress of each activity must be measured each month. A subsection for each activity should follow the summary obligation status. Each subsection should display obligation progress against a straight line plan on a simple graphical representation, backed up by the work request documentation and monthly reports of obligation which should contain explanations for significant deviations.

b. Contract Status Reports

This section should contain a one page report from the Procuring Contracting Officer (PCO) on the status of negotiations in progress. As a minimum the report should identify the name of the contractor, type of contract, areas of agreement, significant problem issues (with government position vs contractor position) and a prognosis. The report should be made at least monthly or more often if the situation dictates.

At least equally important as the status of ongoing negotiations for future contracts is information regarding the administration of existing contracts. It is through the vehicle of contract administration that the program manager controls the major dollar value of his project. It is most important to the program manager to keep apprised of the potential for the contractor to deliver on time and at or below cost. Since schedule and cost are so important they are given their own section of the control system and will be discussed in the following paragraph on Financial and Cost Reports. Another key

FIREBRAND
SUMMARY OBLIGATION STATUS
FY 78



Explanation: Each month the obligations for each activity are summarized to this display. The bar chart is an effort to show the percentage of funds authorized that have been obligated. In the example created above, obligations as of the end of November for the three activities have been made up to illustrate the form:

	Annual Authorization	Funds To Date	Obligations To Date (11/30)	Over/Under Obligation
TRA	5,890	1,475	950	(33)
THIOKOL	600	150	120	20
NADC	200	50	20	(13)

From back up data, it is clear that TRA is behind a straight line obligation rate. With $1,475 authorized for the first quarter, 2/3 (or about $983) should be obligated by 30 November. With only $950 obligated, TRA is shown by the bar graph to be short of the line depicting the end of November. The amount "(33)" is shown for specifics. The fact made obvious by the graph, must, of course, be investigated further before taking any reprogramming action.

Figure 6-3

element in contract administration concerns performance. This control over the engineering progress of the development is part of the Master Engineering Plan which is beyond the scope of this current effort.

Other significant elements of contract administration that are addressed in this area of the control system include: changes, protests, disputes, government equipment, legal concerns, etc. One of the significant cost growth factors in government contracts is the proliferation of changes subsequent to negotiation of the original contract. In order to control these changes they must be made visible to the program manager. Before being effected, significant changes (above a dollar threshhold designated by the program manager) must be submitted in a one or two page standard format for program manager approval. The proposal must include, as a minimum, the nature of the proposed change, the cost, the positive effect, consequences of not making the change, and alternatives. Once a change has been approved, either an equitable adjustment or a negotiated price change is required. The status of these dollar impacts must be maintained and integrated with the overall cost control.

The other elements noted above will not be discussed in detail, but should be included within the contract status reports section. Appendix B suggests in more detail areas of concern for a contract administrator/project manager.

c. Financial and Cost Reports

Well over 85% of the funds received and budgeted for FY78, FY79 and FY80 are or will be contracted to civilian

contractors, making control of the cost and schedule of those contracts the top business priority for the program manager. Fortunately for the FIREBRAND program manager, DOD Cost/Schedule Control System (C/SCS) reports are requirements of the FIREBRAND contract with Teledyne Ryan Aeronautical (TRA). The job of this area of the management control system is to analyze and report the data from C/SCS in a meaningful manner.

The two most basic indicators of the Cost Performance Report (CPR) are schedule variance and cost variance which tell the program manager whether the program is ahead or behind schedule and at or below anticipated cost. These variances should be tracked month by month to assess their trends and magnitude. It is important to keep the absolute dollar value of the variances in perspective. The percentage relationships and performance indices discussed in Appendix A provide this perspective. Trends are most useful when they can forecast the future. The Latest Revised Estimate (LRE) of the CPR is the future condition must significant to the program manager. Validation of the reported LRE can be accomplished by extrapolating the trends of variance indicators. The details of establishing graphs and reports to validate the LRE are explained in the Army Management Engineering Training Agency (AMETA) publication, Status, Trends and Projections [4] which should be consulted in establishing desired trend analysis charts.

A caution noted in Appendix A is worthy of repetition here. Information from the CPR data represent an effect

which is usually caused by some technical problem. The program manager should be advised of the source of abberations in CPR data and given recommendations as to alternative ways to proceed, including cost and schedule implications.

d. Action Item Reports

Across the entire spectrum of program management concerns there are problem items that will occur which require resolution over a period of time. These problems usually surface during on-site program reviews, in regular monthly progress reports, in the analysis of variances portion of the Cost Performance Report, etc. This section of the management control system is designed to keep track of those problem items including the status of progress being made toward their resolution.

Appendix C describes the Action Item program in more detail. Essentially, a problem is described, catalogued and given a unique problem number. The proposed solution, contractor comments and project management comments are entered, and then an activity is given specific tasks to accomplish with a due date. Update reports are filed as progress or due dates dictate. The data is entered into a computer file which can be dumped periodically to produce both a management summary of all problems and a detailed status of each open problem.

F. IMPORTANCE OF EXCEPTION REPORTING

Underlying the system just described has been a principle not specifically stated, yet vital to the success of control. In view of the vast amount of information bearing on the

management of the FIREBRAND project, the information reported to the project manager must be of an exception nature that highlights problem areas. This principle is perhaps best illustrated in the use of data from the Cost Performance Report of the C/SCS input. The information reported to the project manager as part of the output of the dynamic control system should be that which highlights problems. For example, the project manager should be informed when variances exceed a certain threshhold (to be set by the project manager) in either a positive of negative direction. This principle of exception reporting is equally applicable to all other aspects of the control system.

VII. A MODEL FOR ESTABLISHING CONTROL

A. INTRODUCTION

On the strength of experience gained in this thesis effort, it is possible to establish a model procedure for use by individuals in a management context similar to that of the FIREBRAND Program Manager. The use of this model is not limited to program managers in the Navy, nor for that matter to managers in a matrix organization anywhere. The principles established may be applied by any manager of an organization that is fairly modest in size with a reasonably well defined mission. The process would be useful to the director of a division at a Navy Inventory Control Point or even the head of a department on a ship.

B. THE MODEL

1. A Conceptual Diagram

Figure 7-1 highlights the steps in the process suggested to develop a management control system. The process also may be applied to an organization that has an existing management information/control system in order to refine it and shape it to the needs of a new decision maker.

2. Educational Effort

The first several steps establish the foundation of knowledge necessary to undertake an intelligent design effort.

a. Organizational Analysis

While it may appear obvious, even trite, it is nevertheless very important that the control system designer

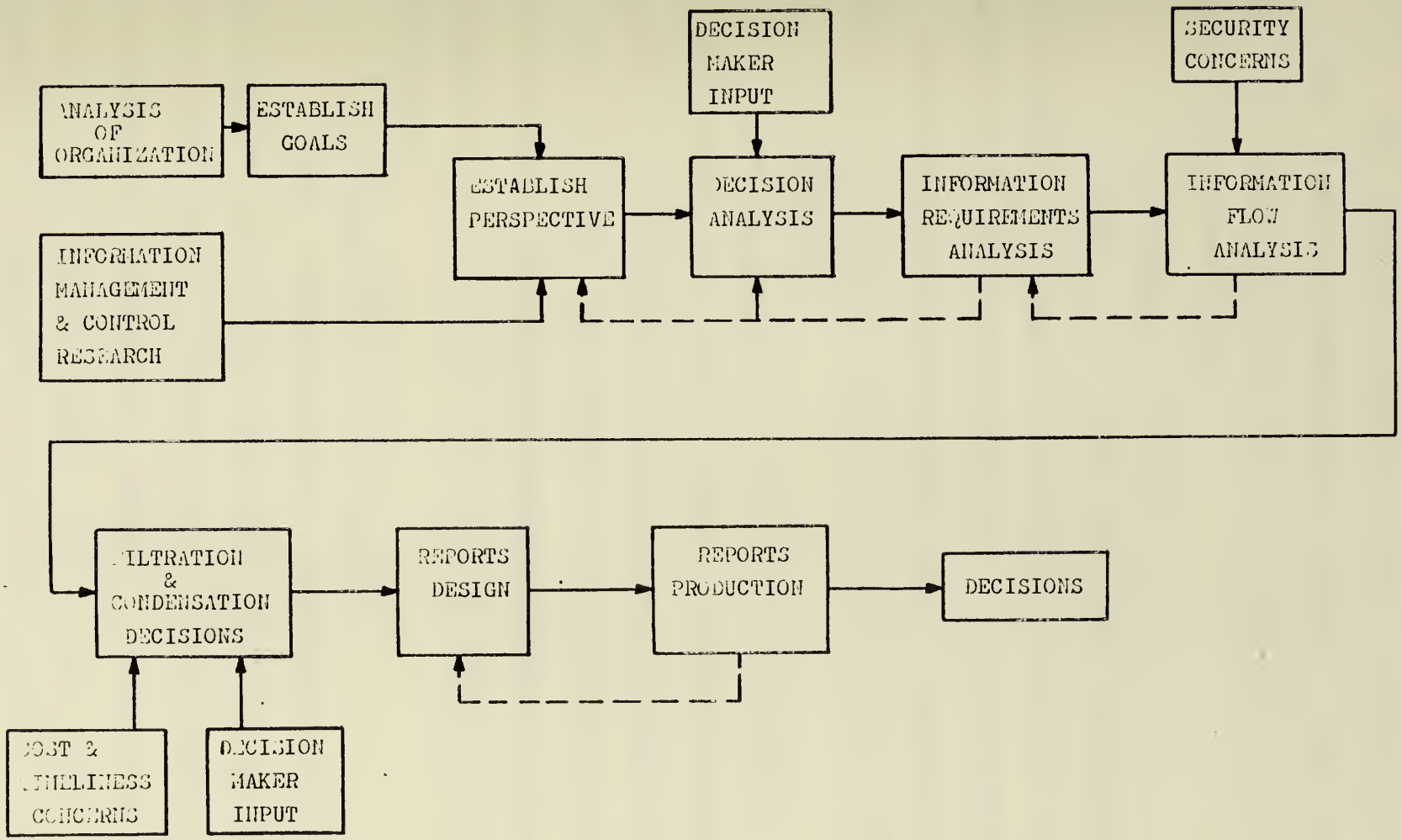

ANALYSIS OF ORGANIZATION
ESTABLISH GOALS
DECISION MAKER INPUT
SECURITY CONCERNS
ESTABLISH PERSPECTIVE
DECISION ANALYSIS
INFORMATION REQUIREMENTS ANALYSIS
INFORMATION FLOW ANALYSIS
INFORMATION MANAGEMENT & CONTROL RESEARCH
FILTRATION & CONDENSATION DECISIONS
REPORTS DESIGN
REPORTS PRODUCTION
DECISIONS
COST & TIMELINESS CONCERNS
DECISION MAKER INPUT

Figure 7-1

understand the organization for which the control system is intended. This analysis should include an appreciation for the informal lines of communication as well as the formal system. The designer should know and understand the basic mission of the organization.

b. Establishment of Goals

If goals do not exist they must be established and clearly stated. If they are already in existence, they must be understood by the system designer. It is the progress toward accomplishment of these goals (which in turn support the mission) that the control system will be required to measure.

c. Research

At the same time as the system designer is learning about the organization and its goals he should be conducting research into the history of information management and control. As a minimum, this research should include reading Robert Anthony's, Planning and Control Systems: A Framework for Analysis [3], and the literature on management information system design.

d. Establishment of Perspective

Once the basic research has been done and the control system designer is comfortable with the information control concepts and an appreciation of the organization, the final step in the educational effort is to establish a perspective for the control system. The designer should understand where the organization fits within Anthony's framework, the general nature of the types of decisions to be made (e.g.

strategic vs control) and the kinds of information that will be required to support those decisions. It may be useful to set this perspective down in writing, to be reviewed and refined as the process continues.

3. Analysis

Once the basic educational effort has led to the establishment of a perspective within which the designer may operate, the work of analysis begins.

a. Decision Analysis

This important and difficult process may be made easier for the system designer who has had no previous experience in making decisions on the level of the organization for which he is designing a control system. The designer should solicit the input of the decision maker; however, caution must be exercised to ensure that the decision maker does not inhibit the creative initiative of the analyst to come up with a fresh outlook on the important decisions required. If the designer/analyst breaks the decision analysis process into two phases he may find it more logical. The first phase would involve a "big picture" general definition of the types of decisions to be made; e.g. financial decisions, technical decisions, etc. Then, within this macro framework, the analyst can move to identify specific decisions required of the decision maker. Decision analysis alone is insufficient to support the development of the entire system. Other forms of analysis must follow. Decision analysis will provide a base for a dynamic control system similar to that described in chapter six.

b. Information Requirements Analysis

Once the specific decisions have been defined, the analyst should determine the information needed to support those decisions. It is not necessary to establish the detailed lists of information necessary for each and every decision; rather it is only required that the general nature of the information be defined. This step should also involve specifying the potential source of the information required.

c. Existing Information Flow Analysis

Once the nature of information needs has been established, it is a natural next step to determine whether any of that information is already provided. At the same time, elements of existing information flows which were not previously identified as needs, should be used to review the requirements analysis to determine whether the existing flow may in fact be needed somewhere. During the analysis of existing information flow, the analyst should be alert to any security concerns which affect the current flow of information in order that they may be applied to the new system. Information analysis tends to support the static portion of the management control system.

d. Feedback

Throughout the analysis process, any knowledge gained in each step of the process should be fed back to the perspective established during the educational phase to refine and perhaps revise that perspective which may then have an effect on the analysis.

4. Implementation

This final phase takes the conceptual structure defined during analysis and puts it into practice.

a. Filtration and Condensation

The value of a management control system lies in its ability to filter out the important bits of information from the wide range of all the information that exists and condense it into a useful format for the decision maker. The degree to which gross information can be filtered depends on the time and money available to do it. Since information has a value that diminishes with time, it must be reported quickly. If it takes too long to condense into a more useful form, the information may become worthless. If it costs more to produce the information than the benefits provided by that information then it is not worth obtaining and condensing. Since he will rely heavily on this filtered information to make decisions, the decision-maker must be intimately involved in the judgment as to what information gets filtered, to what degree and by whom. The filtration condensation must not distort the intent of the information.

b. Reports Design

When the nature of the information to be reported is known, the control system designer may turn to the format of the report. The guiding principle in this regard is simplicity. Reports must be as brief as possible and still transmit their message. The reports must also be action oriented; i.e., provide the decision maker with all that he needs to take action by making a decision.

c. Reports Production

Once their design has been established, initial reports may be produced for use by the decision maker. As these reports are used their design must be reviewed and perhaps revised.

C. SUMMARY

Not every step in this process is required to be pursued to the same degree by every control system designer. If a designer is well versed in the details of the organization and comfortable with its goals he can move more quickly to establishing the perspective. Regardless of the background of the system designer, he should approach the process in some logical manner similar to the order suggested in this chapter. Designing reports before analyzing decisions that need to be made is likely to result in reports that are either excessive or insufficient to meet the needs of the decision maker.

VIII. SUMMARY AND CONCLUSIONS

A. SUMMARY

This thesis has examined the conceptual framework for management control. The concepts of two theoretical frameworks -- one for planning and control and the other for management information systems -- were applied to an existing weapons system acquisition project to develop an outline for a formal management control system. Due to constraints of lack of technical expertise of the author, limited time available and unavoidable importunities of timing (this effort was undertaken during a very busy time for the project office staff who were concentrating much of their effort on a major configuration change and a serious review of the program's cost), only the first part of the job has been done. On the strength of experience gained during this effort, a model has been designed to guide others who may seek to undertake a similar task.

B. CONCLUSIONS

1. Importance of Management Control

Planning and control are two of the more important elements of management, without which a manager probably will make uninformed decisions that may not be focused on the important goals of his organization. These two elements are embodied in Robert Anthony's concept of Management Control.

2. System Acquisition Perspective

The FIREBRAND Anti-Ship Missile Target (ASMT) acquisition project which is well into the development stage of the

acquisition process is squarely within the Management Control area of Anthony's framework. Not all acquisition projects will be classified as falling in this area. A newer project, in the early stages of design might fit more appropriately nearer to the definition and needs of the strategic planning area. A more mature project (indeed, the FIREBRAND project as it evolves into the production phase) would be defined by Anthony as in the Operational Control area of his framework. It is an important first step to understand the perspective of the project before proceeding too far along with decision analysis and information system design.

3. Decision Orientation

A management control system should be designed with a view toward the nature of the decisions to be made by the manager. The Gorry and Scott-Morton framework for management information systems defines three types of decisions made by managers operating within Anthony's framework. Most of the decisions being made by the FIREBRAND Program Manager are of the unstructured or semi-structured nature. The implications of this are that the information required to support those decisions is similarly undefined. The management control system structured to report that kind of information must contain a broad range of information on which the decision maker can draw to respond to short-fuzed, unstructured, non-repetetive type questions and problems.

4. Control System Design

The design of a management control system is a complex process that should not be undertaken lightly. While it

is not considered appropriate to employ to total systems approach to management control system design, the process should be orderly and well planned. Before beginning any substantive work on the system, the designer should educate himself on the basic concepts of management control and management information systems. Then, after developing a good appreciation for the workings of the organization for which the system is being designed, he should proceed with an analysis of decisions and information leading ultimately to a simple, responsive structure for management control.

C. RECOMMENDATIONS

1. Establishment of the System

The system framework proposed in chapter six should be used by the FIREBRAND Project Office in considering its needs, its existing system, and any resultant changes required. The precise format of the reports should be modified to accommodate the desires of the ultimate user -- the Program Manager.

2. Extension of the System

Once the initial business oriented portion of the system is set up and running to the satisfaction of the program manager, work should continue with the establishment of a system to control the technical progress of the project. The program developed by Systems Consultants Inc. (SCI) is considered an excellent base for this technical control system.

3. Further Study

Follow-on work in the establishment and extension of the system using the model suggested in chapter seven is

advised. Testing the model in related but different organizations would be desireable.

APPENDIX A

COST/SCHEDULE AND CONTROL SYSTEM (C/SCS)

The DOD Cost/Schedule Control System (C/SCS) is designed to measure cost, schedule and technical performance of contractors in the acquisition processes. The two principle directives associated with C/SCS are:

DOD Instruction 7000.2

DOD Instruction 7000.10

A. C/SCS CRITERIA

DOD Instruction 7000.2, "Performance Measurement for Selected Acquisitions," establishes criteria for an effective contractor cost/schedule control system. These criteria are intended to establish a common base of data that may be aggregated into reports at high summary levels within DOD. There are five criteria specified in DOD Instruction 7000.2. They are, (1) Organization, (2) Planning and Budgeting, (3) Accounting, (4) Analysis and (5) Revisions. These criteria are summarized and explained in a DOD presentation on Instruction 7000.2 as follows:

1. Organization

Contractors are required to define all work and resources using the contract work breakdown structure (WBS). The internal structure of the contractor's organization (and major subcontractors) must be integrated with the WBS. Cost accounts must be established for each unique managerial level

dictated by the WBS. A typical WBS is illustrated in figure A-1. The integration of the organization with the WBS may be seen in figure A-2.

2. Planning and Budgeting

The criteria established in the planning and budgeting area are that the contractor must:

a. Schedule all work at the lowest defined element of the WBS.

b. Identify physical products, milestones, technical performance goals, or other indicators that will be used to measure output.

c. Establish budgets to the lowest level of contract planning (work package) by cost element.

d. Identify the relationships of budgets or standards of underlying work authorization systems to budgets for work packages.

As was the case with criteria for organization, the intent of planning and budgeting criteria is to integrate all effort within the WBS.

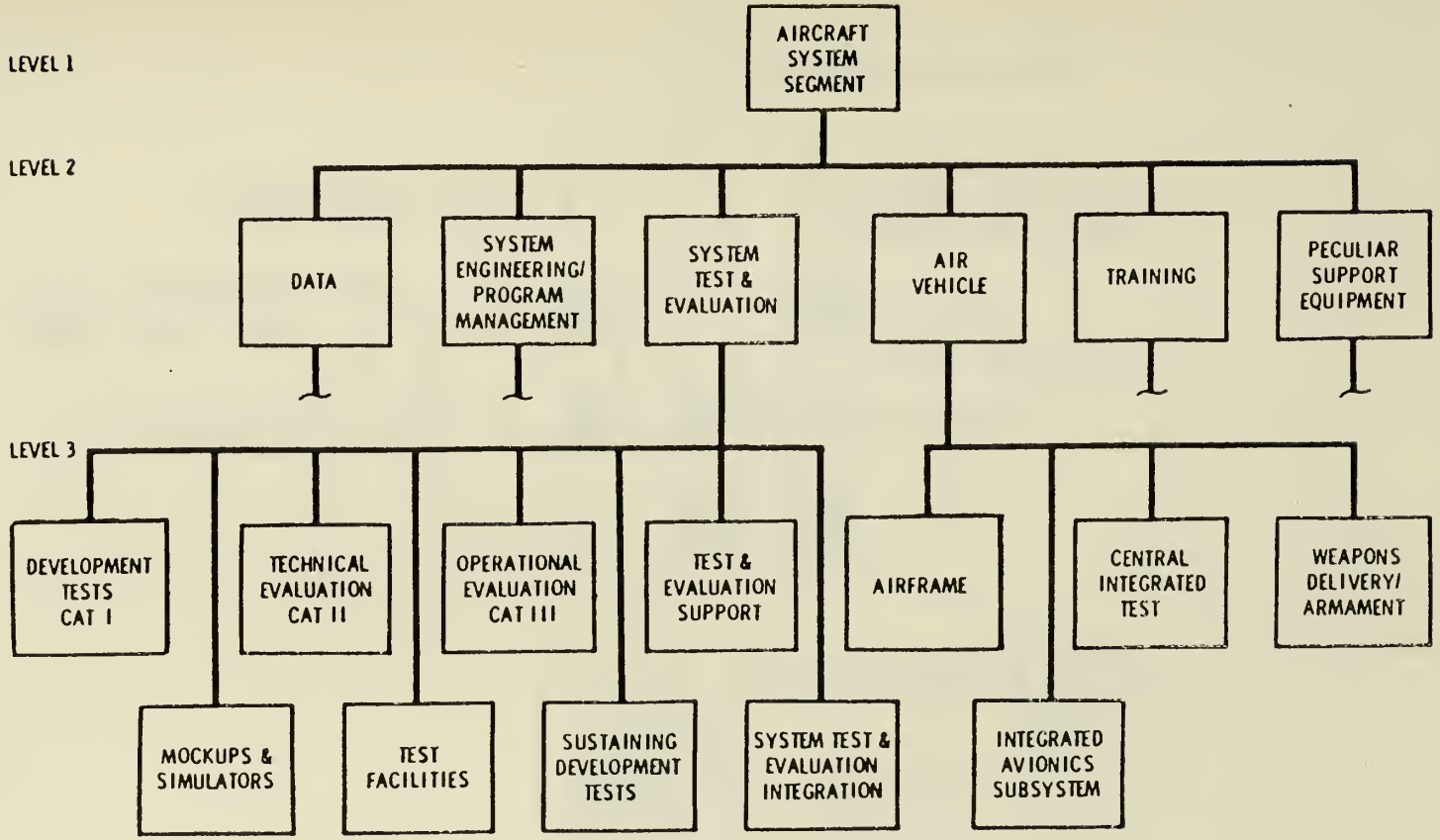
3. Accounting

Criteria for accounting practices are summarized as follows:

a. Apply actual cost consistent with budgets.

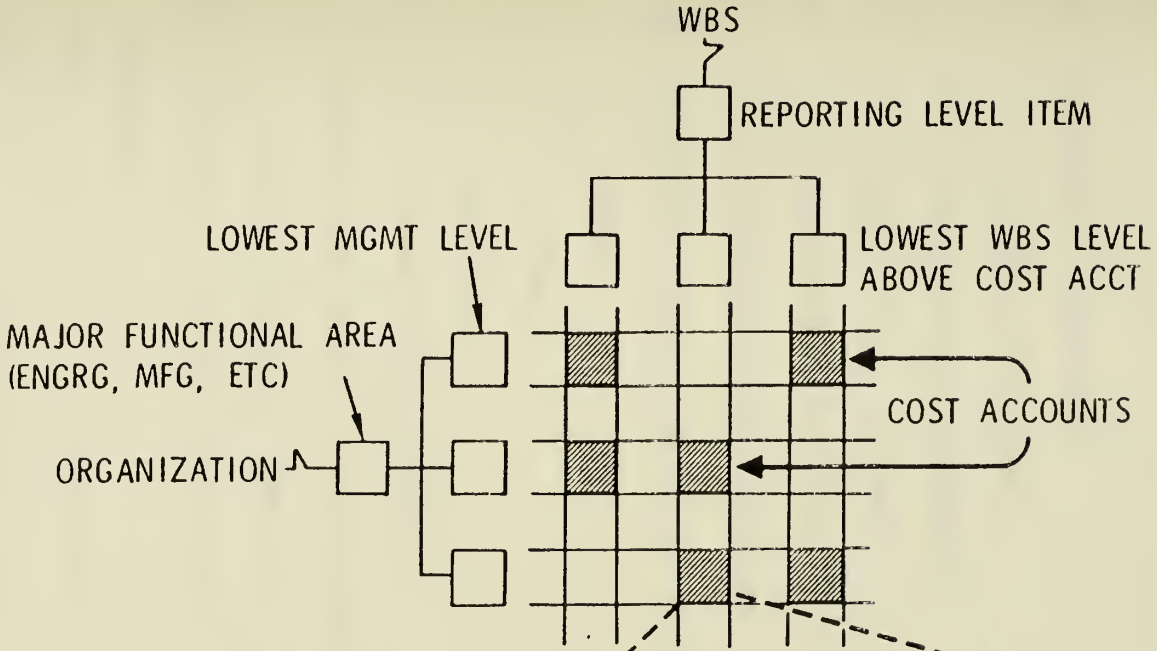
b. Summarize actual cost from cost accounts directly into the WBS. There shall be no allocation to two or more WBS elements.

PROGRAM WBS



(Figure A-1)

WBS/ORGANIZATION INTEGRATION



COST ELEMENT	BUDGET	BCWS	BCWP	ACTUAL COST
LABOR HR				
LABOR $				
MATL $				
ODC $				
OH $				
TOTAL $				

(Figure A-2)

c. Summarize actual cost from cost account directly into the functional organization.

d. Record all costs.

4. Analysis

The focus of the criteria for analysis is consistent with the principle of management by exception; e.g., the identification of variances from the plan. Analysis criteria are:

a. Identify Variances

(1) Schedule Variance

(2) Performance Variance

(3) Labor Rate Variance

(4) Overhead Rate Variance

(5) Material Rate Variance

b. Classify these variances in terms of:

(1) Labor

(2) Overhead

(3) Material

(4) Other Direct Costs

c. Variances shall be routinely analyzed and explained.

d. Variance analysis shall be used routinely as a basis for managerial corrective action.

5. Revisions

The bottom line on revisions to the scope of the project is that they will be made expeditiously upon approval and never retroactively. Specifically, the instruction calls for:

a. Incorporation of contractual changes in a timely manner.

b. Prohibition on retroactive changes to applied cost except for errors and routine adjustments.

c. Preventing revisions to the contract budget baseline except for government directed changes to the contractual effort.

d. Advising the procuring activity - immediately - of any baseline budget or schedule changes.

e. Minimizing changes to work packages.

When viewed as a whole, these criteria are designed to establish a cost/schedule control system that will produce management information which will allow the program manager to understand those specific areas of the project that are not proceeding according to plan and whether those variances affect cost or schedule or both.

B. REPORTS

DOD Instruction 7000.10 establishes reporting requirements within the C/SCS. The three reports described are, (1) Cost Performance (CPR), (2) Contract Funds Status Report (CFSR) and (3) Cost/Schedule Status Report (C/SSR).

1. Cost Performance Report (CPR)

The CPR is designed to report data for use in measuring contractors' cost and schedule performance, in order to provide early identification of problems having significant cost impact and for use in making and validating management decisions. The CPR presents data in five distinct formats.

a. Format One

Illustrated by figure A-3, CPR Format One presents data to measure cost and schedule performance arranged by summary level work breakdown structure elements. Data is reported for the current period (usually one month) and cumulative for the project/contract to date, with projections for the project at completion. Actual work performed for each WBS element is compared against plans, and variances in schedule and cost are noted.

b. Format Two

Figure A-4 illustrates Format Two which provides similar data as that on Format One except that it is broken down by organizational or functional cost categories rather than WBS. For example, Format Two may provide data for such categories as, Production, Manufacturing Support, Engineering, etc., which provides a different perspective on the variances.

c. Format Three

This format is illustrated by figure A-5. It describes the budget baseline plan against which performance is measured. This part of the CPR shows the original contract target cost, any negotiated changes to date, and potential changes that have been approved except for pricing (unpriced work). The budgeted cost of work scheduled is shown as it stands through the date of the report, and forecasted for each of the next six months, and the balance of the contract broken down into specified periods (e.g., six month periods). In

addition to funds budgeted directly to scheduled work, the report also reveals the total amounts budgeted for general and administrative costs and as a management reserve.

d. Format Four

Figure A-6 illustrates Format Four of the CPR. This format provides manpower loading forecasts for correlation with the budget plan and cost estimate predictions. The organizational or functional categories used in Format Two are displayed here with numbers of equivalent man-months for each category for the current period, and cumulative through the end of the project. The arrangement of data in this form permits easy comparison with the baseline budget plan (Format Three) and against variances by functional category (Format Two).

e. Format Five

The Problem Analysis Report (Format Five) is illustrated by figure A-7. This is a narrative supplement to the other pages of the CPR intended to be used to explain significant cost and schedule variances and other contract problems. This data is supposed to be used by the program manager to: (1) evaluate contract performance, (2) identify actual and potential problem areas having significant cost impact, and (3) provide valid, timely program status information to higher authority.

f. General

The requirement for submitting the CPR is called out in the basic contract. It is usually submitted monthly. The level of detail to be reported normally will be limited to

level three of the WBS or higher, except where problem areas are indicated. The specific variance threshholds requiring analysis and explanation are negotiated between the government and the contractor.

2. Contract Funds Status Report (CFSR)

The CFSR is intended to provide funding data to assist DOD management in: (a) updating and forecasting contract fund requirements, (b) planning and decision making on funding changes, (c) developing fund requirements and budget estimates, and (d) determining when excess funds are available. To accomplish these ends, the form requires data on funds authorized, commitments, and expenditures accrued through the date of the report and projected into the future for the duration of the contract. Figure A-8 illustrates the CFSR.

3. Cost/Schedule Status Report (C/SSR)

The C/SSR is designed to take the place of the CPR in small contracts. The same data as is required in the heading of Format Three of the CPR (Original Target Cost, Changes, Unpriced Work and Total Baseline Budget) combined with the performance data of Format One is merged into a single form illustrated by figure A-9. Data is to be reported to level three of the WBS or higher. Reports are required as specified in the contract, but not to exceed monthly.

C. ANALYSIS

The data provided in the reports required by C/SCS will be useful only to the extent that it is transformed into meaningful information through analysis. The U.S. Army Management

Engineering Training Agency (AMETA) offers a course which includes instruction on techniques for analysis of C/SCS data. An AMETA developed publication, Status, Trends and Projections [4] is used in that course and though the foreword of that publication disclaims its utility outside the classroom, it has been observed to be a significant working tool for defense contractors who report into C/SCS. The information in this section of Appendix A is drawn liberally from that publication. Readers interested in more depth should obtain a copy from AMETA which is located in Rock Island, Illinois.

1. Technical Foundation

Cost and schedule performance status, trends, and forecasts usually do not, within themselves, constitute an end product; rather, they represent an effect which is the result of some cause. More than likely, some technical problem exists that is causing a cost or schedule variance. These causes must be identified and corrected to reverse the trend of an unfavorable variance. Cost and schedule information merely highlight situations and evoke questions which are generally satisfied by some technical answer. This relationship between C/SCS data and the real source of problems associated with weapons acquisition should be borne in mind throughout any analysis of C/SCS data.

2. Performance Measurement System Attributes

A performance measurement/control system follows a logically sequenced set of events from which an analyst may draw conclusions. The control of an acquisition project is

no exception. Six important attributes of an effective performance measurement/control system are:

a. Identification and Organization of the Work

The system should establish cost accounts such that work is identified to the lowest level of the work breakdown structure (WBS).

b. Establishment of Baselines

All authorized work should be scheduled. Budgets should be assigned to manageable units of work. The time phased summation of these budgets then becomes the established baseline. In C/SCS terms, this is the time-phased budgeted cost of work scheduled (BCWS).

c. Measurement of Current Status

The system should tell whether that which was accomplished is that which was intended, and whether it cost what was projected. In the C/SCS this is budgeted cost of work performed (BCWP) compared against BCWS to get a schedule variance. The actual cost of work performed (ACWP) is compared to BCWP to get cost variance.

d. Identification of Trends

A good system will show whether variances are growing or diminishing. Trend identification relies a lot on historical data.

e. Predicting the Future

Trend analysis itself is interesting, but is of little use unless it helps the decision maker in making decisions about the future.

f. Indicating a Need for Management Action

The best system not only highlights areas which require decisions, but also suggests who must take action to implement the decision.

3. Variance Determination

Calculating variances from the CPR is a relatively straight forward process; in fact, both cost and schedule variances are provided on Format One (refer to figure A-3). Knowing how these variances are calculated, though, is important to appreciating how some of the trends are established.

a. Schedule Variance (SV)

This is understood as indicating how much of the work scheduled to be accomplished (BCWS) has been accomplished (BCWP). In terms of the CPR Format One, this means:

SV	=	BCWP	-	BCWS
(col. 10)		(col. 8)		(col. 7)

As constituted, this simple formula results in a negative figure for schedule variance when the project (or a particular element) is behind schedule.

b. Cost Variance (CV)

This variance highlights the comparison of the planned cost of the work performed in terms of the budget (BCWP) against the actual cost incurred in the accomplishment of the work (ACWP). Using the CPR Format One again:

CV	=	BCWP	-	ACWP
(col. 11)		(col. 8)		(col. 9)

Again, if the figure is negative, then the project is costing more than planned.

Knowing how these variances are computed permits comparison against a base which lends more significance to the variance and its trend. AMETA suggests comparing the schedule variance to the amount of work planned to obtain a schedule variance percentage:

$$\frac{\text{SV (col. 10)}}{\text{BCWS (col. 7)}} = \text{SV PERCENTAGE}$$

The cost variance should be related to the amount of work accomplished:

$$\frac{\text{CV (col. 11)}}{\text{BCWP (col. 8)}} = \text{CV PERCENTAGE}$$

4. Performance Indices and Factors

In addition to the two percentage relationships just described, there are many other indices and factors which may assist the analyst in his attempt to quantify performance. Several suggested by AMETA are:

a. Cost Performance Index (CPI)

The CPI indicates the cost efficiency with which work has been accomplished.

$$\text{CPI} = \frac{\text{BCWP}}{\text{ACWP}}$$

b. Schedule Performance Index (SPI)

The SPI indicates the percentage of work accomplished against that planned.

$$\text{SPI} = \frac{\text{BCWP}}{\text{BCWS}}$$

c. Percent Complete

This index compares the amount of budget (work) accomplished to date with the amount planned for the total contract.

$$\frac{\text{BCWP}}{\text{BAC (col. 12)}} = \text{PERCENT COMPLETE}$$

There are many other such combinations and comparisons which are not discussed here. The point to be made is that variances and other data should have some base against which to be compared in order to be most significant.

5. Trend Analysis

a. General

Past and current data are often used as predictions of future performance. The extrapolation of historical performance trends to establish future positions is an important and practical tool for the analyst. The approach which should be taken relative to data extrapolations is:

(1) Examine current and historical performance data for trends,

(2) Interpret and draw conclusions from the trends,

(3) Use the trends, interpretations and conclusions to predict future positions,

(4) Make decisions on action necessary to amend any future projections that are unfavorable.

b. Data Forms

In order to facilitate trend analysis, data may be presented in different formats. Two common forms illustrated in the AMETA publication are:

(1) Tabular Data

This is the data presented in a chart or a table. Only simple brief pieces of data should be treated in this form as the table or chart is likely to get too busy to be meaningful.

(2) Graphical

The popular line graph or bar chart is very revealing in highlighting trends. Care must be exercised in avoiding oversmoothing which could make changes less easy to detect. Choices exist for displaying data incrementally, cumulatively, as a moving average, along a regression line, etc.

CONTRACTOR LOCATION RDT&E ☐ PRODUCTION ☐	COST PERFORMANCE REPORT - WORK BREAKDOWN STRUCTURE CONTRACT TYPE / NO.:	PROGRAM NAME, NUMBER	REPORT PERIOD:	SIGNATURE, TITLE & DATE	FORM APPROVED OMB NUMBER 22R0280

QUANTITY	NEGOTIATED COST	EST COST AUTH. UNPRICED WORK	TGT PROFIT FEE %	TGT PRICE	EST PRICE	SHARE RATIO	CONTRACT CEILING	EST CEILING

ITEM	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE		BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE		BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
	Work Scheduled	Work Performed		Schedule	Cost	Work Scheduled	Work Performed		Schedule	Cost			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
WORK BREAKDOWN STRUCTURE													
GEN AND ADMIN													
UNDISTRIBUTED BUDGET													
SUBTOTAL													
MANAGEMENT RESERVE													
TOTAL													
RECONCILIATION TO CONTRACT BUDGET BASELINE													
VARIANCE ADJUSTMENT													
TOTAL CONTRACT VARIANCE													
				(ALL ENTRIES IN THOUSANDS OF DOLLARS)									

Format 1

COST PERFORMANCE REPORT, FORMAT 1

(Figure A-3)

LOCATION: RDT&E ☐ PRODUCTION ☐	CONTRACT TYPE / NO.:	PROGRAM NAME/NUMBER:	REPORT PERIOD:	FORM APPROVED OMB NUMBER 22R0250

ORGANIZATIONAL OR FUNCTIONAL CATEGORY	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE		BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE		BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
	Work Scheduled	Work Performed		Schedule	Cost	Work Scheduled	Work Performed		Schedule	Cost			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
GEN AND ADMIN													
UNDISTRIBUTED BUDGET													
TOTAL													
(Note: This total must agree with Subtotal on Format 1)													

(ALL ENTRIES IN THOUSANDS OF DOLLARS)

Format 2

COST PERFORMANCE REPORT, FORMAT 2
(Figure A-4)

CONTRACTOR: LOCATION: ROT&E ☐ PRODUCTION ☐	COST PERFORMANCE REPORT – BASELINE			FORM APPRDVED OMB NUMBER 22R0280
	CONTRACT TYPE / NO.:	PROGRAM NAME/NUMBER	REPORT PERIOD:	

(1) ORIGINAL CONTRACT TARGET COST	(2) NEGOTIATED CONTRACT CHANGES	(3) CURRENT TARGET COST (1) + (2)	(4) ESTIMATED COST OF AUTHORIZED, UNPRICED WORK	(5) CONTRACT BUDGET BASELINE (3) + (4)	(6) TOTAL ALLOCATED BUDGET	(7) DIFFERENCE (5) – (6) (SEE PAGE 5)

ITEM	BCWS CUM TO DATE	BUDGETED COST FOR WORK SCHEDULED (NON-CUMULATIVE)											TOTAL BUDGET
		SIX MONTH FORECAST							(ENTER SPECIFIED PERIODS)				
		+ 1	+ 2	+ 3	+ 4	+ 5	+ 6						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
PM BASELINE (BEGINNING OF PERIOD)													
(LIST BASELINE CHANGES AUTHORIZED DURING REPORT PERIOD)													
GEN AND ADMIN													
UNDISTRIBUTED BUDGET													
PM BASELINE (END OF PERIOD)													
MANAGEMENT RESERVE													
TOTAL													

Format 3

COST PERFORMANCE REPORT, FORMAT 3

(Figure A-5)

R&D T&E ☐	PRODUCTION ☐														
															22R0280
ORGANIZATIONAL OR FUNCTIONAL CATEGORY	ACTUAL CURRENT PERIOD	ACTUAL END OF CURRENT PERIOD (CUM)	FORECAST (NON-CUMULATIVE)												AT COMPLETION
			SIX MONTH FORECAST BY MONTH (ENTER NAMES OF MONTHS)								(ENTER SPECIFIED PERIODS)				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
TOTAL DIRECT															
(ALL FIGURES IN WHOLE NUMBERS)															

Format 4

COST PERFORMANCE REPORT, FORMAT 4

(Figure A-6)

CONTRACTOR: LOCATION RDT&E ☐ PRODUCTION ☐	COST PERFORMANCE REPORT – PROBLEM ANALYSIS			FORM APPROVED OMB NUMBER 22R0280
	CONTRACT TYPE / NO.:	PROGRAM NAME/NUMBER:	REPORT PERIOD:	

EVALUATION

Section 1 - Total Contract: Provide a summary analysis, identifying significant problems affecting performance. Indicate corrective actions required, including Government action where applicable.

Section 2 - Cost and Schedule Variances: Explain all variances which exceed specified variance thresholds. Explanations of variances must clearly identify the nature of the problem, the reasons for cost or schedule variance, impact on the immediate task, impact on the total program, and the corrective action taken. Cost variances should identify amounts attributable to rate changes separately from amounts applicable to manhours.

Within this section, the following specific variances must be explained:

a. Schedule variances (Budgeted Cost for Work Scheduled vs Budgeted Cost for Work Performed)
b. Cost variances (Budgeted Cost for Work Performed vs. Actual Cost for Work Performed)
c. Cost variance at completion (Budgeted at Completion vs. Latest Revised Estimate at Completion)

In addition to the variance explanations above, the following analyses are mandatory:

a. Identify the effort to which the undistributed budget applies
b. Identify the amount of management reserve applied during the reporting period, the WBS elements to which applied, and the reasons for application

Section 3 - Baseline: If the difference shown in block (7) on format 3 becomes a negative value or changes in value, provide:

a. Procuring activity authorization for the baseline change which resulted in negative value
b. The amount (by WBS element) used to adjust for unfavorable performance incurred prior to the baseline change
c. The amount (by WBS element) added to budgets previously established for future effort. Explain reasons for the additional budget in the following terms:
   (1) In-scope engineering changes
   (2) In-scope support effort changes
   (3) In-scope schedule changes
   (4) Economic change
   (5) Estimating change
   (6) Unpredictable change
   (7) Other (specify)
d. The amount (by WBS element) for added in-scope effort not previously identified or budgeted

Format 5

COST PERFORMANCE REPORT, FORMAT 5

(Figure A-7)

Classification

1. CONTRACT NUMBER	3. CONTRACT FUNDING FOR FOR FY	5. PREVIOUS REPORT DATE	7. CONTRACTOR (NAME, ADDRESS & ZIP CODE)	9. INITIAL CONTRACT PRICE: TARGET _____ CEILING _____
2. CONTRACT TYPE	4. APPROPRIATION	6. CURRENT REPORT DATE	8. PROGRAM	10. ADJUSTED CONTRACT PRICE TARGET _____ CEILING _____

11. FUNDING INFORMATION

LINE ITEM/WBS ELEMENT	APPROPRIATION IDENTIFICATION	FUNDING AUTHORIZED TO DATE	ACCRUED EXPENDITURES PLUS UNLIQUIDATED COMMITMENTS TOTAL	CONTRACT WORK AUTHORIZED				FORECAST			TOTAL REQUIREMENTS	FUNDS CARRY-OVER	NET FUNDS REQUIRED
				Definitized	Est. Over/ Under Target Cost	Not Definitized	Subtotal	Not Yet Authorized	All Other Work	Subtotal			
a.	b.	c.	d.	e.	f.	g.	h.	i.	j.	k.	l.	m.	n.

12.

	CONTRACT WORK AUTHORIZED (WITH FEE/PROFIT) - ACTUAL OR PROJECTED										
	ACTUAL TO DATE										At Completion
a. UNLIQUIDATED COMMITMENTS											
b. ACCRUED EXPENDITURES											
c. TOTAL (12a + 12b)											
13. FORECAST OF BILLINGS TO THE GOVERNMENT											

REMARKS:

DD FORM NO 1 JAN 72 1586 PREVIOUS EDITIONS ARE OBSOLETE

GPO 929.098

Classification

Page ___ of ___ Pages

(Figure A-8)

CONTRACTOR: LOCATION: R&D&E ☐ PRODUCTION ☐	COST/SCHEDULE STATUS REPORT			SIGNATURE, TITLE & DATE	FORM APPROVED OMB NUMBER 22R0327
	CONTRACT TYPE / NO.:	PROGRAM NAME-NUMBER	REPORT PERIOD:		

Contract Data

(1) ORIGINAL CONTRACT TARGET COST	(2) NEGOTIATED CONTRACT CHANGES	(3) CURRENT TARGET COST (1) + (2)	(4) ESTIMATED COST OF AUTHORIZED, UNPRICED WORK	(5) CONTRACT BUDGET BASELINE (3) + (4)

Performance Data

WORK BREAKDOWN STRUCTURE	CUMULATIVE TO DATE					AT COMPLETION		
	BUDGETED COST		ACTUAL COST WORK PERFORMED	VARIANCE		BUDGETED	LATEST REVISED ESTIMATE	VARIANCE
	Work Scheduled	Work Performed		Schedule	Cost			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
GEN AND ADMIN								
UNDISTRIBUTED BUDGET								
MANAGEMENT RESERVE								
TOTAL								

(Figure A-9)

7000.10 (Encl 3)
Aug 6, 74

APPENDIX B

Design of a Contract Administration Management Control and Information System

General Requirement: The need for information that impacts on cost, schedule and performance.

Specific Requirements:

PRI*	Information Needs	Responsible Individual(s)	Use of Information
A	Financial & Cost: Above or below target Contractor solvency Funding Availability	Cost/Price Analyst DCAA Financial	Progress payments Validation Compliance Progress pmts.
A	Performance Standard for quality tests, inspection, acceptance Quality Deficiency Reports	Engineering/Prod/ QA, Contract Administration Officer (CAO)	Correct problems, sched changes, making payment, customer satisfaction
A	Schedule: Contract Delinquency Production Delivery Labor Disputes Technical Progress	Industrial spec. Contractor Engineers	Cost/Sched/Perf. implications NLRB/FMCS action
A	Contract Mod Status Responses Due Proposal Control ECP/VE	Administrative Contracting Officer (ACO) & team	Cost/Sched/Perf implications Funding Availability
A	Analysis of Performance & Trends	ACO & staff	Reporting requirements
A	Problems - Real & Potential	Contractor Ind Spec. ACO & team	Cost/Sched/Perf Used for mgmt prob solving
A	Internal Review Opportunity for Improvement	ACO & staff	Ensure compliance, identification of probs., solve prob, keep people on toes
B	Subcontract Admin Procurement systems evaluation (same as between ACO & prime)	Prime & ACO	Same as between ACO & prime

*Only general levels of priority have been assigned to information needs. "A" is considered more important than a "B" priority item; but no effort has been made to distinguish among those assigned priority "A".

PRI	Information Needs	Responsible Individual(s)	Use of Information
B	Protests/Disputes	ACO	Cost/Sched/Perf, Funding Develop strategy to fight for PCO
B	Regulatory & Statutory Requirements	Applicable Division	Compliance enforcement
B	Government Equipment & Material	Property Admin. Ind. Specialist QA	Use, condition, availability Cost of delay
C	Status of Proposed Contracts	PCO Contractor	Projected Load & Scheduling
C	Internal Office Administration	ACO	Workload Allocation Obtaining Resources
C	State & Adequacy of Training	ACO	Training Program
C	Security Classification, Control & Protection constraints Clearances	Security Specialist	Ensure compliance
C	Safety	OSHA	Correct Deficiencies
C	Sources of Support Other Gov't Agencies SYSCOM, Legal, DCAA, SBA, PCO, OLA, etc.	ACO, SYSCOM	As needed for assistance

Other issues to consider across all management information needs and uses:

Priorities, system control, updating procedures, frequency of reporting/action, use of exception data, satisfying reporting requirements, use of a management model (uniquely designed), categories of information (e.g., job, reporting, change, long term, short term, macro level, micro level, functional discipline, interrelationships.

APPENDIX C

FIREBRAND ACTION ITEM PROGRAM

A. GENERAL OVERVIEW

This program is available from the VITRO corporation and with minor modification can be adapted for use by FIREBRAND. The program records and tracks problems from inception to resolution. Each problem is assigned a unique six-digit number that facilitates sorting. Input forms provide opportunity for brief narrative description of the problem along with a proposed solution and comments by the contractor and project office. Actions and due dates may also be assigned. As progress is made toward resolution, update information may be input. The output provides an executive summary for quick review and a more complete analysis of the progress of each open problem.

B. SPECIFICS

1. Numbering System

Each problem is assigned a unique six-digit number which will allow immediate identification of the problem area. The first digit identifies the major area of concern. The second digit may be used to describe a sub-area. Digits three and four may be used to designate the source within which the problem was first identified; e.g. 11 could represent program review #1, 12 is program review #2, etc. Digits five and six identify the particular problem within the sub-area. A suggested numbering system is illustrated in figure C-1. The

major areas and sub-areas are subjected to revision or expansion as necessary to meet the needs of the program manager. The last major field is intended to permit members of the project office to file reminders to themselves or receive direction from the program manager.

2. Input

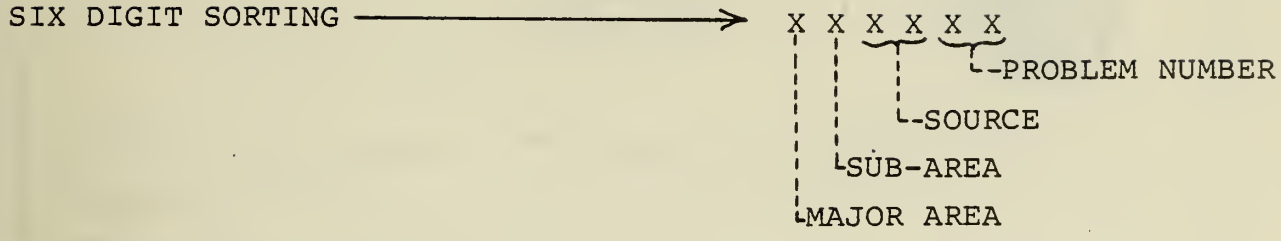
Initial input is made on the format illustrated in figure C-2. The form is generally self explanatory. Narrative comments should be brief and to the point. Update of progress is input in the format illustrated in figure C-3.

3. Output

The program provides two output formats. A management summary similar to figure C-4 provides a quick overview of the status of each problem. More detailed back-up information is provided in a format similar to figure C-5.

ACTION ITEM

NUMBERING SYSTEM



MAJOR AREAS AND SUB-AREAS

1 -- Business Management
- 11 - Budget Submission
- 12 - Budget Execution
- 13 - Contract Negotiation
- 14 - Contract Administration
- 15 - Cost Control
- 16 - Personnel
- 17 - Travel

2 -- Airframe
- 21 - Aerodynamics
- 22 - Structures
- 23 - Electrical System
- 24 - Recovery System
- 25 - Destruct System

3 -- Propulsion
- 31 - Engine
- 32 - Fuel System
- 33 - Booster

4 -- Guidance and Control System
- 41 - Hardware
- 42 - Software

5 -- Target Auxiliary Systems

6 -- Reliability and Maintainability

7 -- Test and Evaluation

8 -- Safety

9 -- Integrated Logistic Support

0 -- Program Direction
- 00 - Program Manager
- 01 - Deputy
- 02 - Business Manager
- 03 - Project Engineer
- 04 - Planning Officer
- 05 - Secretary Staff Assistant

(Figure C-1)

FIREBRAND
ACTION ITEM

CHIT NO: _____ DATE: _____ PROBLEM NO: _____

ORIGINATOR

ORIGINATING ACTIVITY/MTG: _____ CODE/WKG GROUP: _____

PROBLEM AREA: _____

PROBLEM DESCRIPTION: * _____

_____

_____

_____

PROPOSED SOLUTION: * _____

_____

_____

_____

CONTRACTOR COMMENTS: * _____

_____

_____

_____

PROJECT MGMT COMMENTS: * _____

_____

_____

_____

ACTIONS ASSIGNED:

1. _____ _____ _____
   Activity Code (Task to be Accomplished) (Compl Date)
2. _____ _____ _____
   Activity Code (Task to be Accomplished) (Compl Date)
3. _____ _____ _____
   Activity Code (Task to be Accomplished) (Compl Date)

/S/ _____ /S/ _____ /S/ _____
Project Manager Contractor Rep. Action Activity Rep

* CONTINUE ON BACK AS REQUIRED

(FIG C-2)

FROM: _____

TO: COMPACMISTESTCEN (Code 2151)
POINT MUGU, CA 93042

PROBLEM NUMBER: _____

ACTION ITEM UPDATE

(UPDATES MAY BE TYPED OR HAND WRITTEN)

STATUS AS OF _____ (DATE)
ADDITIONAL COMMENTS:

ACTION COMPLETE

_____ YES _____ NO

_____
NEXT ACTION DUE DATE

_____
SIGNATURE

Copy to:
NAVAIR APC-6

Figure C-3

ILSMT MANAGEMENT SUMMARY: FILE FBPA01 7 JUN 78

PROBLEM	*STATUS	*PROBLEM STATEMENT		
210002	OPEN	PARAMETRIC ANALYSIS OF MISSION PERFORMANCE		
	*SOURCE DOCUMENT	*SOURCE DOCUMENT ID	*SOURCE DOCUMENT DATE	
		QTRLY REV A/I	01MAY78	
	*ACTION ACTIVITY	*ASSIGNMENT	*DUE DATE	*STATUS
	TRA	PROV ANALYSIS	01JUL78	CONTG

****

PROBLEM	*STATUS	*PROBLEM STATEMENT		
210003	OPEN	PERFORMANCE BASED ON LAUNCH WEIGHT VERSUS RANGE		
	*SOURCE DOCUMENT	*SOURCE DOCUMENT ID	*SOURCE DOCUMENT DATE	
		QTRLY REV A/I	01MAY78	
	*ACTION ACTIVITY	*ASSIGNMENT	*DUE DATE	*STATUS
	TRA	CONDUCT TRADE-OFF	01JUL78	IN PROCESS

****

PROBLEM	*STATUS	*PROBLEM STATEMENT		
210004	OPEN	PERFORMANCE TREND TRACKING SYS		
	*SOURCE DOCUMENT	*SOURCE DOCUMENT ID	*SOURCE DOCUMENT DATE	
		QTRLY REV A/I	01MAY78	

Figure C-4

78PA01 PROBLEM NO 200002 7 JUN 78*

SUBJECT : FIREBRAND PROGRAM
ILS ELEMENT :
KEY WORD : AVIONIC FUNCT DESC

PROBLEM SOURCE:	ACTIVITY	NAME	DOC ID	DOC DATE
			QTRLY REV A/I	01MAY78

PROBLEM DESCRIPTION : A functional description of avionics system is required.

PROPOSED SOLUTION : Write a functional description of the operation of the total avionics equipment.

ACTION TAKEN#:#31MAY78 - APC-6, ref (a), reported that the Avionics sub-systems working group has been requested to consolidate this and all other items pertaining to avionics into a meaningful list of actions required.

ACTION SUMMARY :	ACTIVITY	ASSIGNMENT	DUE DATE	STATUS

REFERENCES :	IDENTIFICATION	REFERENCE BRIEF
	(a)APC-6 UPDATE OF 31MAY78	REPTD ACT STATUS

Figure C-5

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